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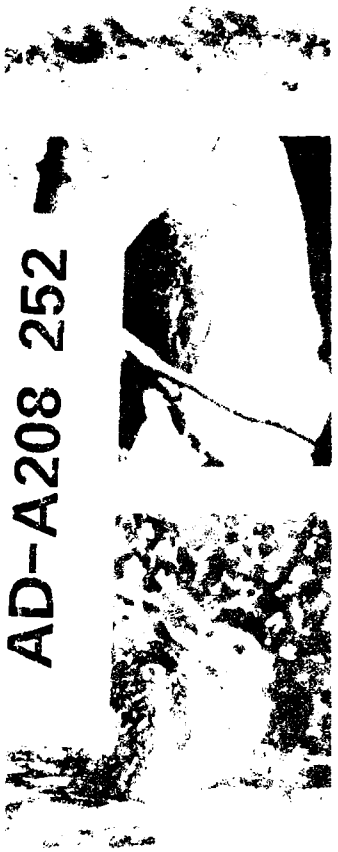

ENVIRONMENTAL LABORATORY

DEPARTMENT OF DEFENSE
NATURAL RESOURCES PROGRAM

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AMERICAN WOODCOCK (*Scolopax minor*)

Section 4.1.2, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

Thomas H. Roberts

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39181-0631

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A report on the American woodcock (*Scolopax minor*) is provided as Section 4.1.2 of the US Army Corps of Engineers Wildlife Resources Management Manual. The purpose of the report is to provide Department of Defense and Corps of Engineers biologists with the information necessary to properly manage installation or project lands for this species. Major topics covered include species description, breeding biology, population characteristics, habitat requirements, food habits, management practices, and census and survey methods.

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PREFACE

This work was sponsored by the Department of Defense (DOD) military branches under the DOD Natural Resources Program. Technical Monitors for the study were representatives of the Fish and Wildlife Committee of the Defense Natural Resources Group, DOD. The report serves as a section of the US Army Corps of Engineers Wildlife Resources Management Manual, as developed by the Headquarters, US Army Corps of Engineers, under the Environmental Impact Research Program.

This report was prepared by Dr. Thomas H. Roberts, Resource Analysis Group (RAG), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, RAG, was principal investigator for the work unit. Review and comments were provided by Dr. James S. Wakeley, Ms. L. Jean O'Neil, and Mr. Martin, EL; Dr. Ralph W. Dimmick, Department of Forestry, Wildlife, and Fisheries, University of Tennessee, Knoxville, Tenn.; and Mr. Greg F. Sepik, US Fish and Wildlife Service, Moosehorn National Wildlife Refuge, Calais, Maine.

The report was prepared under the general supervision of Mr. H. Roger Hamilton, Chief, RAG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. The report was edited by Ms. Jessica S. Ruff of the WES Information Products Division (IPD). Drawings were prepared by Mr. David R. (Randy) Kleinman and Mr. John R. Harris, Scientific Illustrations Section, IPD, under the supervision of Mr. Aubrey W. Stephens, Jr.

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NOTE TO READER

This report is designated as Section 4.1.2 in Chapter 4 -- WILDLIFE SPECIES ACCOUNTS, Part 4.1 -- GAME BIRDS, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 4.

AMERICAN WOODCOCK (*Scolopax minor*)

Section 4.1.2, US ARMY CORPS OF ENGINEERS

WILDLIFE RESOURCES MANAGEMENT MANUAL

The American woodcock (*Scolopax minor*) is an upland game bird that inhabits many of the forested areas of eastern North America. Woodcock are closely associated with young, second-growth hardwoods but need a diversity of forested, shrubby, and open habitats to satisfy their life requirements. The species is distinctive with its large, high-set eyes, chunky body, rounded wings, and extremely long beak (Fig. 1); however, the birds are seldom seen except when moving between nocturnal and diurnal cover at dawn and dusk or when performing crepuscular courtship displays in early spring. The woodcock is often called the "timber-doodle," sometimes abbreviated simply to "doodle."

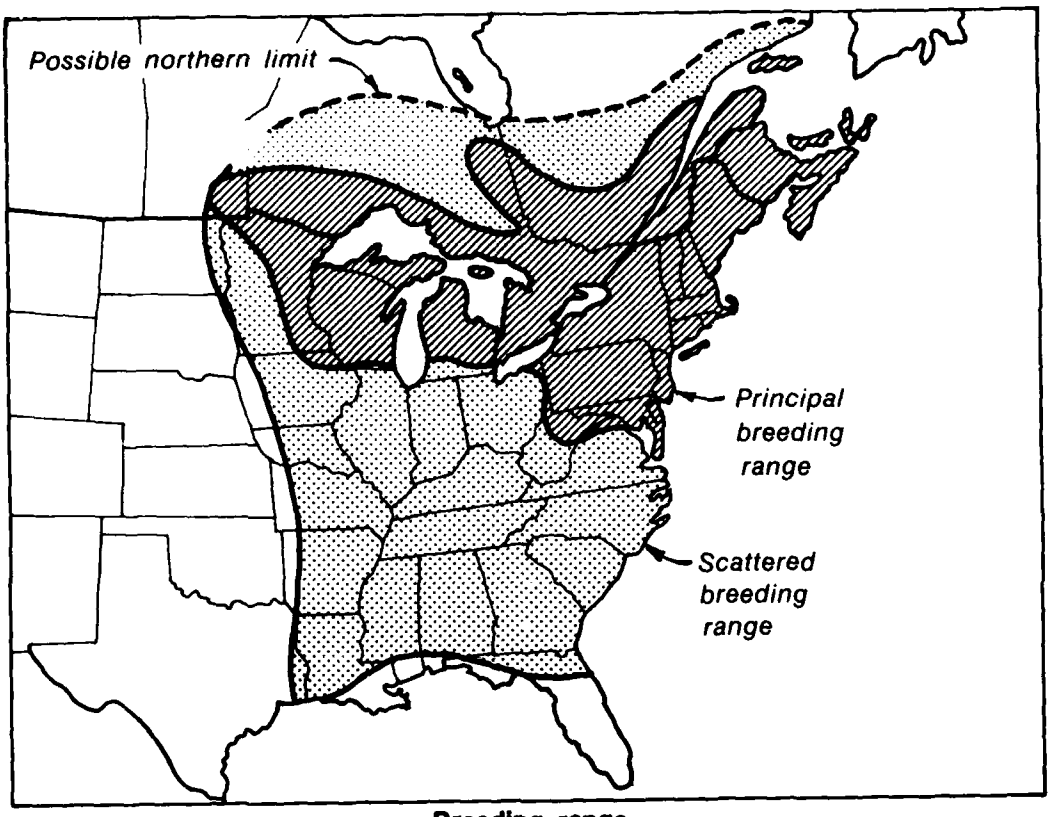
Figure 1. The American woodcock (photo by James E. Hudgins, Pennsylvania State University)

The species is in the sandpiper family (Scolopacidae); its only close relative is the similar but larger European woodcock (*Scolopax rusticola*).

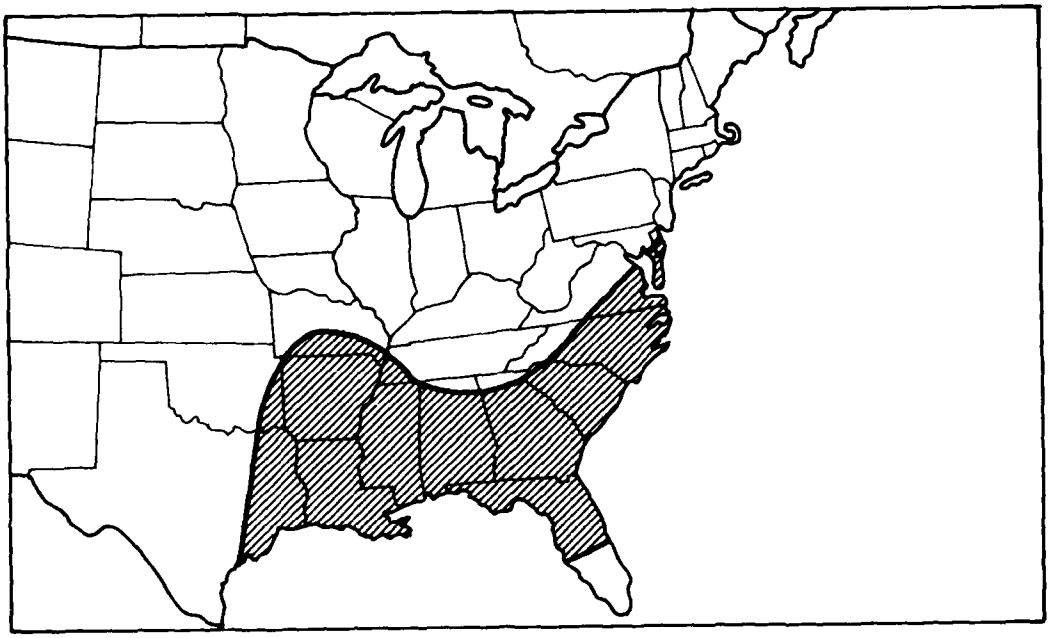
DISTRIBUTION

The range of the American woodcock extends from the Maritime Provinces in southern Canada westward to southeastern Manitoba. The western edge of the range follows a line southward into eastern Texas. All states east of this line are within the species' range (Fig. 2). The principal breeding area includes New England and the Lake States although limited breeding occurs throughout almost the entire range. Woodcock winter primarily from Louisiana eastward through the Gulf States and the Carolinas, with considerable overlap in the breeding and wintering range. Woodcock were released in California in 1972-73, but their status there is unknown (Owen 1977).

There are no recognized subspecies of woodcock, although there appears to be minimal interchange of birds across an area corresponding roughly to the



Breeding range



Winter range

Figure 2. Breeding and winter ranges of the American woodcock (*Scolopax minor*) (after Sheldon 1967 and Owen 1977)

Appalachian Mountain chain. As there are 2 relatively discrete subpopulations, the Eastern and Central Regions have been established for management purposes (Coon et al. 1977) (Fig. 3).

STATUS

The woodcock is an important game species and is hunted in 34 states and 5 Canadian provinces. The species is most sought after in the northern portion of its range where it is often hunted in conjunction with ruffed grouse (*Bonasa umbellus*). The leading woodcock harvest states include Maine, Michigan, New York, Pennsylvania, and Wisconsin (Owen 1977). Except in Louisiana, there is little tradition of woodcock hunting in the South, and the species is generally taken incidentally by small game hunters. However, Wood et al. (1985) noted that changing demographics along with declining bobwhite quail

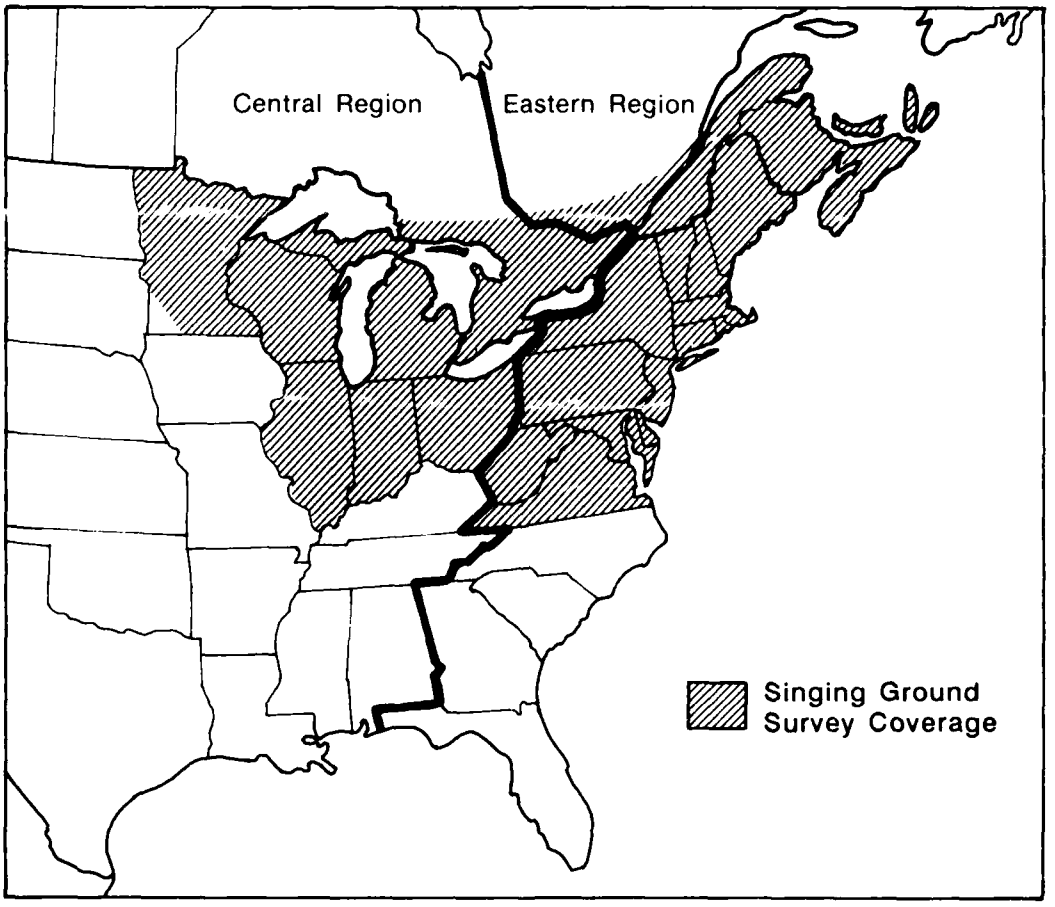


Figure 3. Woodcock management regions and Singing Ground Survey coverage

(*Colinus virginianus*) populations have potential to generate additional interest in woodcock hunting in the South.

There is no single estimate of annual woodcock harvest or of the number of woodcock hunters. The best information comes from state harvest surveys and from the US Fish and Wildlife Service's (USFWS) waterfowl harvest survey. These sources indicate that 700,000 hunters annually harvest 2 million woodcock (US Fish and Wildlife Service 1985). The harvest is split between the 2 management regions with an average of 827,000 birds taken annually in the Eastern Region and 1,173,000 in the Central Region. It is estimated that hunters annually spend 3.5 million man-days hunting woodcock (USFWS 1988).

CHARACTERS AND MEASUREMENTS

Description

The woodcock is a mottled brown bird approximately the size of a bobwhite. The breast is a light cinnamon color, and the back and sides are washed with black. The head is gray and brown with a series of 3 or 4 black bars across the crown. The wings are short and rounded. The legs are very short and feathered on the upper part. The woodcock's most striking features are its large high-set eyes and extremely long (59 to 71 mm) beak.

Chicks are covered with black and brown mottled down at hatching. Growth is rapid, and by 2 weeks of age chicks are able to fly; after 4 weeks they are similar to adults in size and plumage (Owen 1977).

The woodcock's eggs are a pinkish buff to cinnamon color and are covered with light brown spots or blotches overlaid with darker markings. The shell is smooth and oval in shape (Harrison 1975). The eggs are large relative to the size of the bird. Pettingill (1936) reported an average size of 38 × 29 mm based on 53 eggs (range from 35 × 27.5 mm to 41 × 40 mm).

Sex Determination

Plumage characteristics of male and female woodcock are nearly identical. Although there is some overlap, females tend to be larger and weigh from 160 to 240 g whereas males weigh from 125 to 190 g (Owen and Krohn 1973). The most reliable techniques for determining sex are based on measurements of the beak and wings (Fig. 4). Mendall and Aldous (1943) found that beak length could be used for sexing woodcock, but there is some error associated with intermediate values.

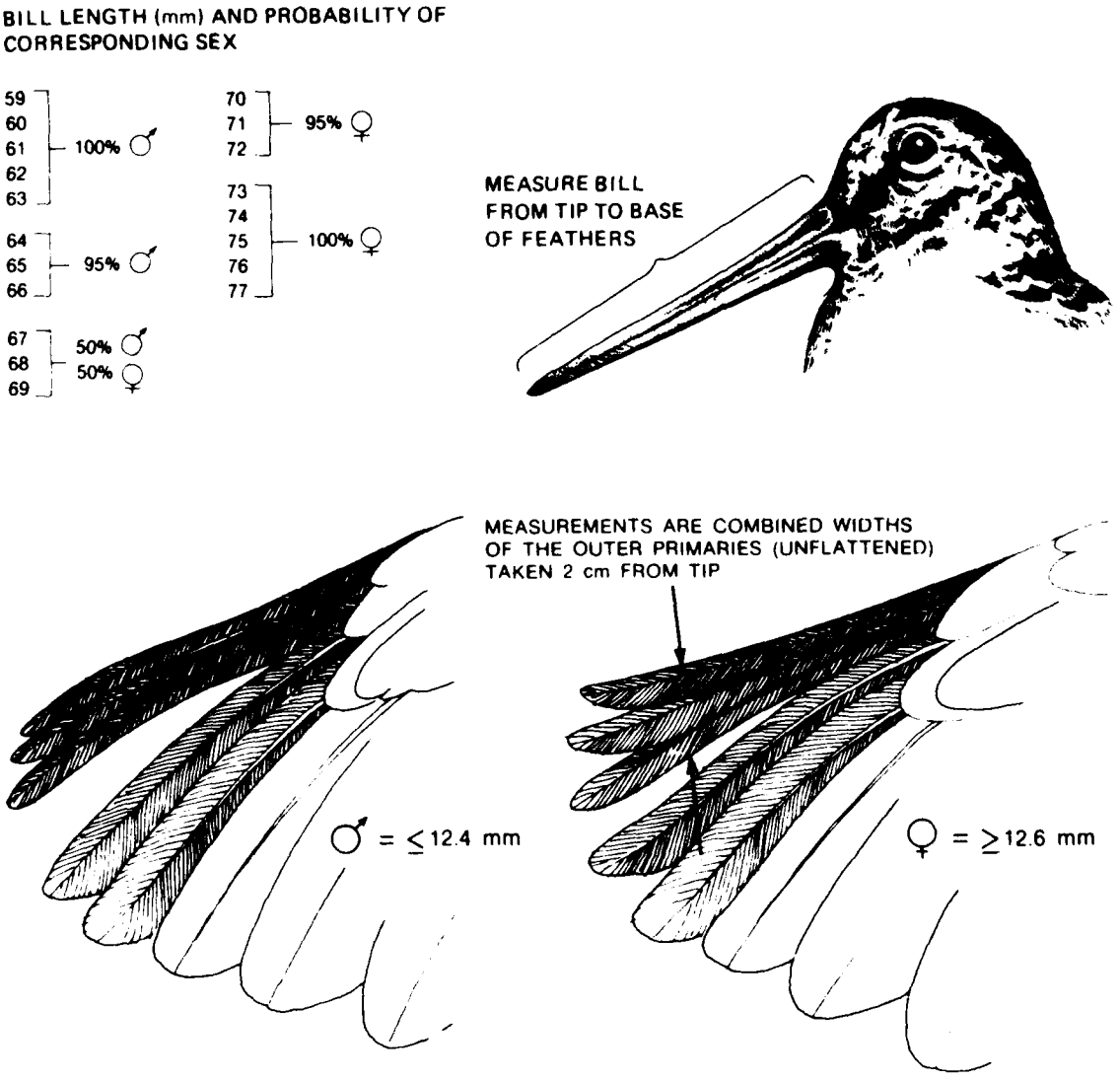


Figure 4. Methods for sex determination in American woodcock. Bill lengths (top) and outer primary feather widths (bottom) can be used to distinguish male and female woodcock (after Liscinsky, nc date)

Blankenship (1957) used the combined width of the 3 outer primaries in conjunction with beak length to reduce error to less than 1 percent. He found that birds having combined feather widths of ≤12.4 mm were always males while those ≥12.6 mm were females. When the measurement was 12.5 mm, or when the primaries were missing, beak length also had to be used.

When only wings are available and measurements of primary widths are borderline or cannot be taken because of missing or molting feathers, total wing length can be used (Artmann and Schroeder 1976). Wings are measured from the notch at the bend to the end of the longest primary (usually the seventh). If primary 7 is missing, primary 6 is used; if both are missing, the technique cannot be used. Wings measuring ≤133 mm are from males, whereas those ≥134 mm are from females.

Toe and shank lengths were found to be highly correlated with sex (Clark 1978), but the degree of overlap in intermediate values limits the usefulness of these measurements alone. Clark recommended using them in conjunction with bill and feather measurements, noting that these additional data should be useful in sexing birds with borderline bill and wing values.

For practical field application, a visual examination of the widths of the three outer primaries is the most useful. An experienced observer can readily determine the sex of most woodcock; only those with borderline widths require measurements.

Age Determination

After woodcock have molted their downy plumage and reach adult size (from March to August depending on latitude), 3 age classes can be identified in a population: immatures (young of the year), subadults (birds hatched in the preceding calendar year), and adults (birds hatched earlier than the preceding year). Age determination is based on the pattern and color characteristics of the secondary wing feathers (Martin 1964) (Fig. 5). Immatures retain their primaries and outermost 10 to 12 secondaries throughout their first year. The secondaries have a light-colored terminal band that is adjacent to a distinct dark band. Adult secondaries retain the light-colored tip but lack the distinct band. From spring until the molt in late summer, immatures can be confused with subadults since both have the subterminal band on the secondaries. In subadult birds, these feathers will be at least a year old and may be faded and worn. Wear on the tertiaries and axillars may also be used to

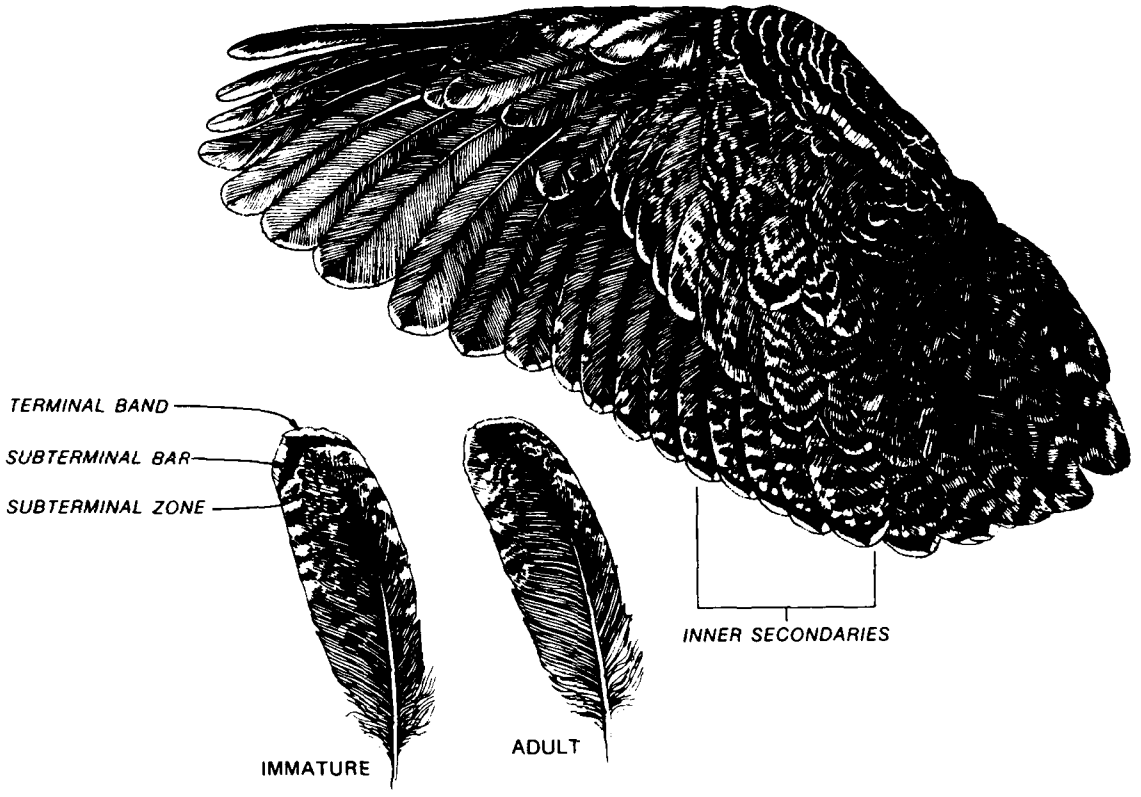


Figure 5. Patterns of inner secondary feathers used to distinguish adult and immature American woodcock (after Martin 1964)

differentiate between immatures and subadults during this period (Greg Sepik, Wildlife Biologist, Moosehorn National Wildlife Refuge, Calais, Maine, pers. commun., 1988). After the late-summer molt until young are born the following spring, only immatures and adults can be distinguished by these criteria.

Sheldon et al. (1958) used microscopic examination of the barbs near the tip of the outer 3 primaries to distinguish between adults and immatures during fall. The primaries of adults are only 1 to 3 months old at this time and the barbs have straight, even tips. Because immatures do not molt their primary and outer secondaries until their second summer, these feathers may be 5 to 8 months old. They typically have a frayed, ragged appearance and may be notched in a "V" shape where the down was attached. By November, adult primaries also show wear, thereby reducing the reliability of the method.

Shissler et al. (1981) developed a technique for separating immatures from adults and subadults during summer. They found that immature birds have dark gray neck bands and dark feet and beaks (Fig. 6). Birds hatched in

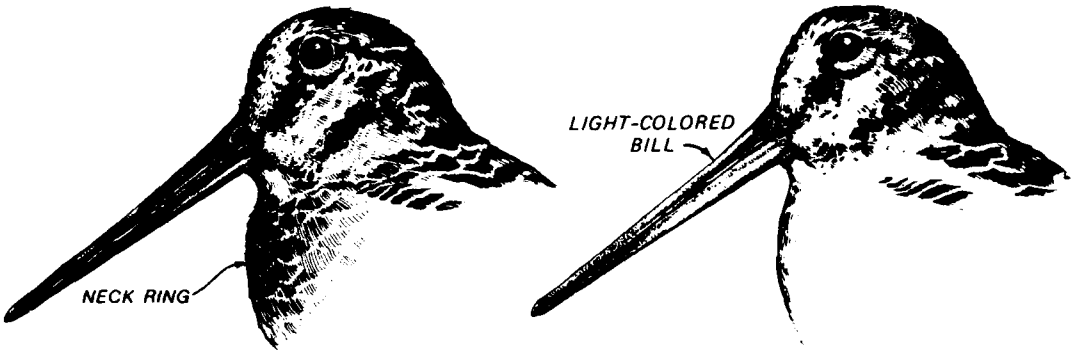


Figure 6. Neck plumage and bill color used to distinguish immatures from adults and subadults (after Shissler et al. 1981)

previous years do not have the neck band and generally have pink or lighter colored feet and beaks. The technique can be used through late summer or early fall and is most valuable during wet weather when feather characteristics are hard to see. Sepik (pers. commun.) noted that the technique has not proven to be particularly reliable in Maine, especially under poor lighting conditions.

BREEDING BIOLOGY

Woodcock may be polygamous; the males at least are promiscuous (Sheldon 1967, Johnsgard 1975). No pair bond forms between the male and female, with the female being responsible for incubation and care of the chicks (Sheldon 1967).

Breeding Age

Both sexes are capable of breeding in their first year of life (Sheldon 1967), but there is some evidence that older birds may breed earlier in the year. Subadult males become sexually active at the same time of the season as adult males (Roberts 1980), yet adults are much more common (72%) on established singing grounds during the first part of the breeding season (Whitcomb 1974). This suggests that adult males are more successful at establishing and maintaining territories. This "age differential breeding" may be necessary for the species to maintain optimum reproductive efficiency (Whiting et al. 1984). There is also evidence that adult hens breed earlier in the season

than do subadults. Walker and Causey (1982) found that only adult hens breed during January and February, the first part of the reproductive period in Alabama. Whiting and Boggus (1982) found no evidence of subadult females nesting in eastern Texas and concluded that adult hens were responsible for all the nesting activity there.

Breeding Season

Woodcock are among the earliest breeders of North American birds. Male courtship activity may begin as early as mid-December in the Southern States (Stamps and Doerr 1977, Whiting and Boggus 1982), although nesting does not occur until late February through mid-March (Causey et al. 1974, Stamps and Doerr 1977, Roberts and Dimmick 1978). There is a gradual progression in breeding chronology with increasing latitude, with woodcock arriving on the northern breeding grounds during late March or early April (Sheldon 1967). The breeding period lasts approximately 1.5 months (Sheldon 1967), although activity on some singing grounds may continue for over 2.5 months (Roberts, personal observation). In northern Maine and Canada, the majority of nesting occurs from mid- to late-April (Couture and Bourgeois 1974, Dwyer et al. 1982). Most chicks hatch by mid-May (Sheldon 1967, Dwyer et al. 1982), but late-June hatching dates have been reported (Whitcomb 1974, Dwyer et al. 1982).

Courtship

Males establish and maintain breeding territories called "singing grounds" on old fields or forest openings and perform crepuscular aerial displays for the purpose of attracting females for copulation. The display begins after the male alights in an open area of his singing ground. It is initiated on the ground with the male walking around in a small area (usually only a few square meters) uttering a loud, nasal, insect-like sound described as a "peent." Preceding each peent is a soft gulp or "tuko" that can be heard only up to 20 to 30 m (65 to 98 ft). The peent call is given approximately every 20 sec. This ground display may last 5 min or more, although periods of approximately 2 min are more common. After peenting ceases, the bird flushes and begins a slow spiraling climb to a height of 60 to 150 m (200 to 500 ft). Sheldon (1967) found the height of 3 flights made by 1 bird to be 84 m (275 ft). The area encompassed by the spiral is approximately 1.1 ha (2.7 acres) (Pettingill 1936). During the ascent there is a constant

twittering sound made by the wings. The descent is much quicker than the ascent and follows more of a zigzag pattern than a spiral. During the descent, the twittering ceases and is replaced by a series of chirps that sounds like a "liquid warble." At 15 to 30 m (50 to 100 ft), this sound stops, and the remainder of the descent is silent.

These displays occur twice daily beginning about 15 min after sundown and 30 to 45 min before dawn. Pettingill (1936), Mendall and Aldous (1943), and Duke (1966) all reported that a light intensity of 2 footcandles triggered courtship. Mean lengths of the evening display period range from 23 min in North Carolina (Stamps and Doerr 1977) to over 40 min in Maine and Michigan (Mendall and Aldous 1943, Duke 1966). Sheldon (1967) stated that, in general, performances are longer in the northernmost parts of the breeding range. The length of the evening display may also vary throughout the breeding period. Sheldon (1967) reported that April performances in Massachusetts averaged 24 min, while May performances averaged 38 min.

If the male is successful in attracting a female, mating occurs on the ground. Copulation lasts only a few seconds and is rarely observed as it normally occurs in near darkness. Male courtship is influenced by several environmental factors. Stormy weather, high winds, heavy rain, and freezing temperatures all result in curtailment of breeding activity (Sheldon 1967).

Nesting

Clutch size is generally 4 eggs (Fig. 7), except for late nests, which may contain only 2 or 3 (Mendall and Aldous 1943, Liscinsky 1972). Of 115 nests examined by Mendall and Aldous, all but 7 (6.1%) had 4 eggs; the others had 3. All nests examined by Sheldon (1967) (n = 30) and Roberts (1978) (n = 7) contained 4 eggs. Woodcock hens may occasionally lay in another hen's nest (Sheldon 1967); a nest found in Alabama contained 12 eggs (Lincoln 1951).

The hen lays 1 egg per day until the clutch is completed (Sheldon 1967). Incubation lasts for 20 to 21 days (Johnsgard 1975). Relatively few studies have focused on egg fertility and hatching success, although indications are that both are quite high. Mendall and Aldous (1943) reported that fertility was 98.4% for 453 eggs they examined and that hatching success was 67%. Whitcomb (1974) found that 92.7% of 55 eggs he observed were fertile, and the hatching success was 85%. Nesting success (the percentage of nests

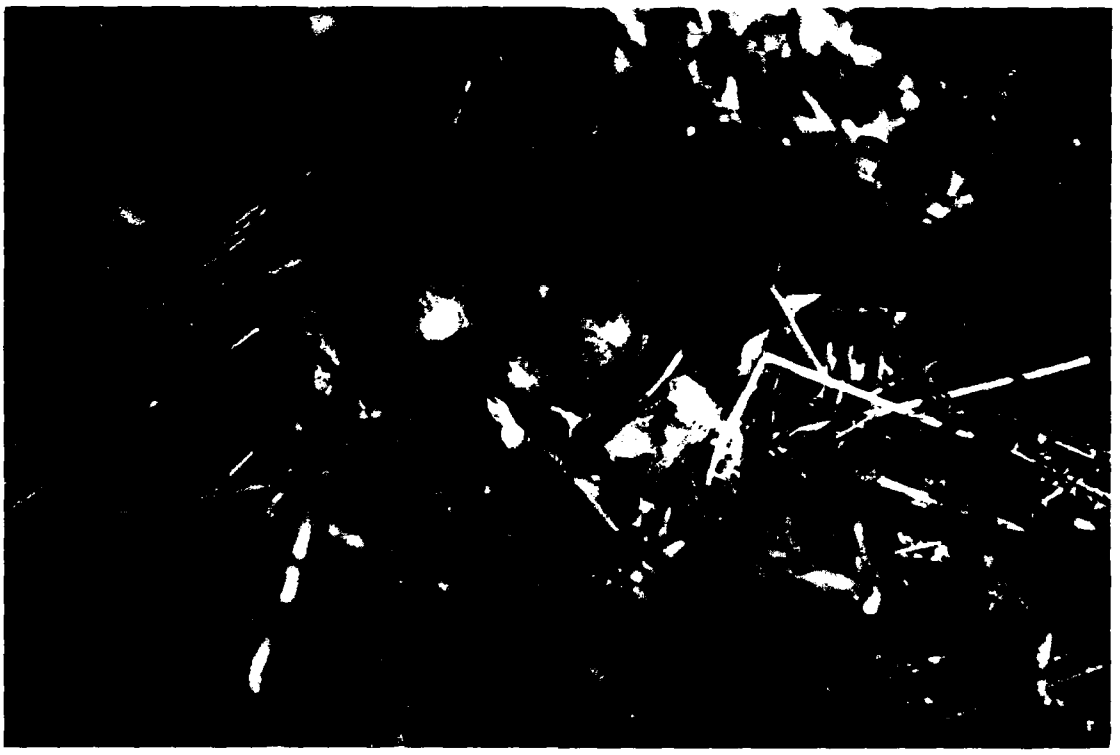


Figure 7. American woodcock nest and eggs

from which at least 1 egg hatches) is approximately 75%, among the highest of all game birds (Mendall and Aldous 1943).

Brood Size

Brood size averages slightly over 3, but may range from 1 to 8 (Blankenship 1957, Whitcomb 1974). Studies conducted in the northern portion of the range have reported an average brood size of 3.0 in Pennsylvania (Liscinsky 1972), 3.1 in Wisconsin (Gregg 1984), 3.3 in Maine (Dwyer et al. 1982), and 3.5 in Michigan (Whitcomb 1974). Roboski and Causey (1981) reported a slightly smaller brood size of 2.6 from Alabama. Dwyer et al. (1982) analyzed data from 100 broods observed over a 4-year period and found that brood size varied with the age of the hen. Hens over 1 year old averaged 3.5 chicks per brood while those in their first breeding season averaged 2.9 years old.

Chick Survival

Survival of chicks is high through their first 2 to 3 weeks (after approximately 15 days they can fly and are harder to capture or observe). Mendall and Aldous (1943) reported that chick survival is more than 90%,

noting that this is among the highest of all North American game birds. Recent studies involving a large number of broods support their conclusions. Gregg (1984) compiled data on 301 broods in Wisconsin. He found that chick mortality during the first 3 weeks of the brood period was only 0.04 chick/day. Dwyer et al. (1988) calculated a 59% survival rate (from hatching to fledging) for 102 broods in Maine. An overall survival rate could not be calculated from the data presented by Gregg (1984).

An ongoing telemetry study suggests that weather exerts a significant influence on survival of chicks. Sepik (pers. commun.) has found that wet conditions occurring shortly after hatch may greatly reduce survival and that survival may vary considerably from year to year.

POPULATION CHARACTERISTICS

Sex Ratio

Sheldon (1967) reported that the overall sex ratio of the woodcock population was 82 males:100 females. The ratio was approximately even for immatures (103 males:100 females), whereas the adult ratio was imbalanced (63 males:100 females). Artmann (1975) also found a disparate sex ratio for adults based on 10 years of wing collection data. Immatures were almost evenly divided (104 males:100 females); however, among adults, females were much more common (67 males:100 females). Both studies were based on birds taken in the fall harvest and therefore are dependent on the assumption of equal vulnerability to shooting. Dwyer and Nichols (1982) found some evidence, although inconclusive, that females may be slightly more vulnerable to harvest. Although the exact sex ratio is not known, it is probable that, unlike most game birds, woodcock females outnumber males by a considerable extent.

The disparity in the overall sex ratio is not due to an imbalance in the population of young birds since Dwyer et al. (1982) found an overall ratio of 1:1 during a 4-year brood investigation in Maine. Interestingly, they observed a great deal of variability in the sex ratio of fledged woodcock from year to year; for example, in 1978 the ratio was 47 males:100 females, while in 1979 it was 229 males:100 females. They speculated that during environmentally stressful years, chick production favored males since they are smaller and may be more energy "cost effective" to raise. However, the authors felt that approximately equal numbers of both sexes would be produced over time.

The skewed sex ratio observed in adults appears to be due to differential natural mortality (Dwyer and Nichols 1982) and probably does not occur until after the bird's first fall (Gregg 1984). Two factors may be responsible for the increased mortality among males. First, there is the tendency for males to begin their northward migration in advance of females (Glasgow 1958, Owen 1977, Roberts and Dimmick 1983). Thus, they may arrive in northern areas when snow and freezing conditions can still occur and may be more susceptible to starvation (Dwyer and Nichols 1982). Second, males are probably more prone to predation because they advertise their presence so conspicuously on singing grounds (Sheldon 1967).

Age Ratio

Age ratios during fall are approximately equal (106.6 immatures: 100 adults) based on wings collected over a 10-year period (Artmann 1975). Other studies also provide support that the fall ratio is approximately even (Liscinsky 1972, Gregg 1984). During summer, however, immatures tend to predominate in samples from a population (Krohn 1971, Whitcomb 1974, Gregg 1984). It is likely that immatures are more abundant than adults during summer; however, it is possible that the skewed age ratios are not representative of the true population structure. Adult woodcock undergo a complete molt during summer while immatures undergo only a partial one. Gregg (1984) theorized that the increased energy demands on adults may reduce the frequency of crepuscular flights, thus making them much less likely to be captured by mist-netting or night-lighting. In view of this possible bias, summer data should not be used to estimate age structure, productivity, or other population parameters.

Dynamics

The dynamics of the continental woodcock population are poorly understood for 2 reasons. One is that relatively few woodcock are banded; consequently, the number of band returns has been inadequate for a thorough analysis. Another is that there is variability in production and survival rates between birds from the Eastern and Central Regions, and variability in survival among sex and age classes (Dwyer and Nichols 1982). In spite of these problems, some generalizations regarding population dynamics can be made. Based on analysis of birds banded and recovered from 1967 to 1977, Dwyer and Nichols (1982) concluded that survival rates of females are higher than those of males

and that adults have higher survival rates than young. Young males have the lowest survival rates of any segment of the population, due mainly to the high mortality they experience in the Eastern Region. These data are summarized by region, age class, and sex in Table 1.

Table 1. Estimates of annual survival rates of woodcock banded from May through July, 1967-77

	Adult		Immature	
Management Region	Male	Female	Male	Female
Eastern	0.35	0.49	0.20	0.36
Central	0.40	0.53	0.36	0.31

A telemetry study by Derleth and Sepik (1988) reflected the same general pattern of survival but provided some additional insight regarding seasonal dynamics. They found that the summer to fall survival rate was much higher for adults (range 0.89 to 0.92 percent) than for immatures (range 0.64 to 0.68 percent). This difference was attributed to higher predation on immatures. The high survival rate for adults suggests that the majority of their annual mortality occurs during other periods of the year.

Annual Productivity

A survey of wings from birds harvested by hunters during fall is used to calculate a ratio of immatures to adult females. This ratio, called a recruitment index, provides an indication of the year's breeding success (reflecting only the US portions of the Regions). The indexes, which are adjusted to a base year (Fig. 8) tend to fluctuate annually, probably in response to weather. No trend is evident for the Eastern Region, while the Central Region has shown a statistically significant decline (Bortner 1988).

Population Trends

The Singing Ground Survey, coordinated by the USFWS (Fig. 3), is the main source of information used to assess the status of the continental woodcock population. This survey, which provides an index to the abundance of breeding males, is particularly useful for determining annual changes. Long-term

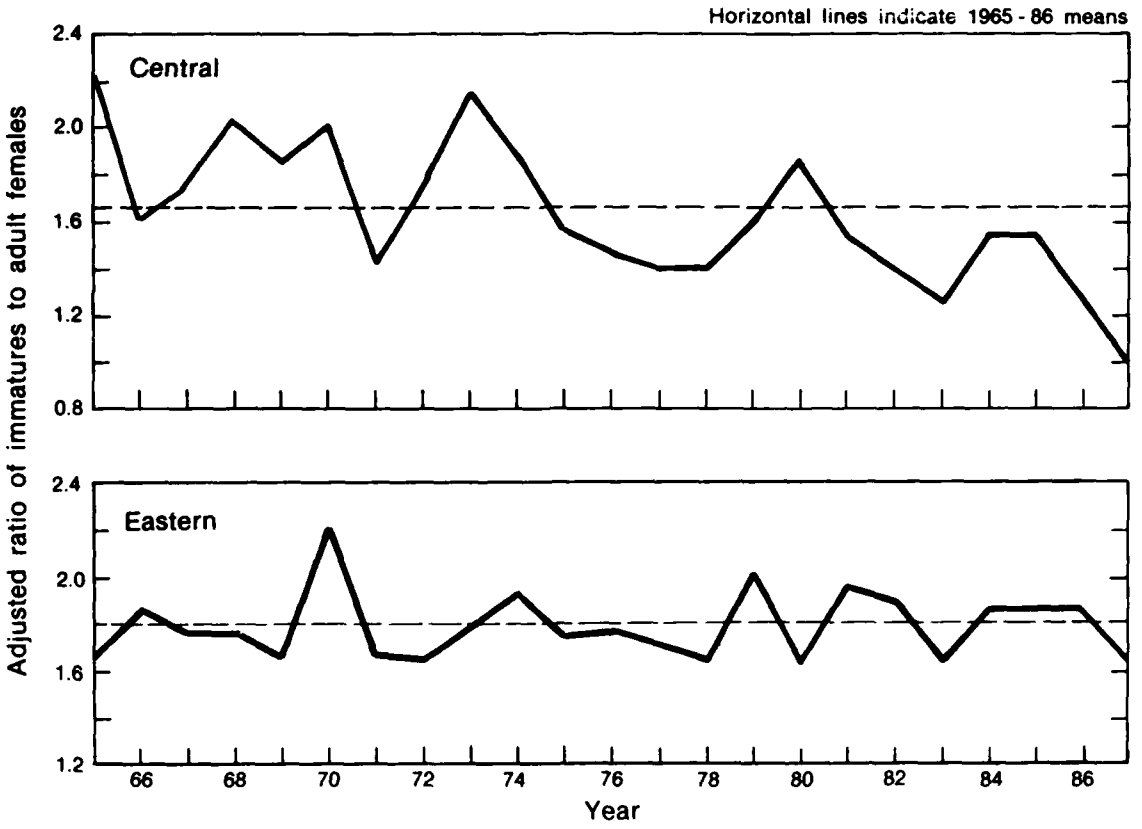


Figure 8. Estimates of annual woodcock productivity based on wing surveys for the Eastern and Central Regions (after Bortner 1988)

trends in both regions are shown in Figure 9 (Bortner 1988). Because the indices are adjusted to a base year, the graphed values do not match those mentioned in the following paragraphs.

The 1988 index in the Eastern Region is 1.80 singing males per survey route (Bortner 1988). The index has been relatively stable over the past few years with a slight upward trend, but is still considerably below the levels of the early 1970's. Over the long term, the Eastern Region has shown an average annual decline of 2.2% from the baseline year of 1968. The management objective of the USFWS is 2.25 birds per route; this level is felt to be one at which the population can sustain a reasonable harvest and satisfy recreational demands (USFWS 1985). Habitat loss through urbanization and forest maturation appears to be the major reason for the decline (Dwyer et al. 1983).

The population index in the Central Region is somewhat higher than in the Eastern Region. The 1988 index is 3.67 males per route, which is near the

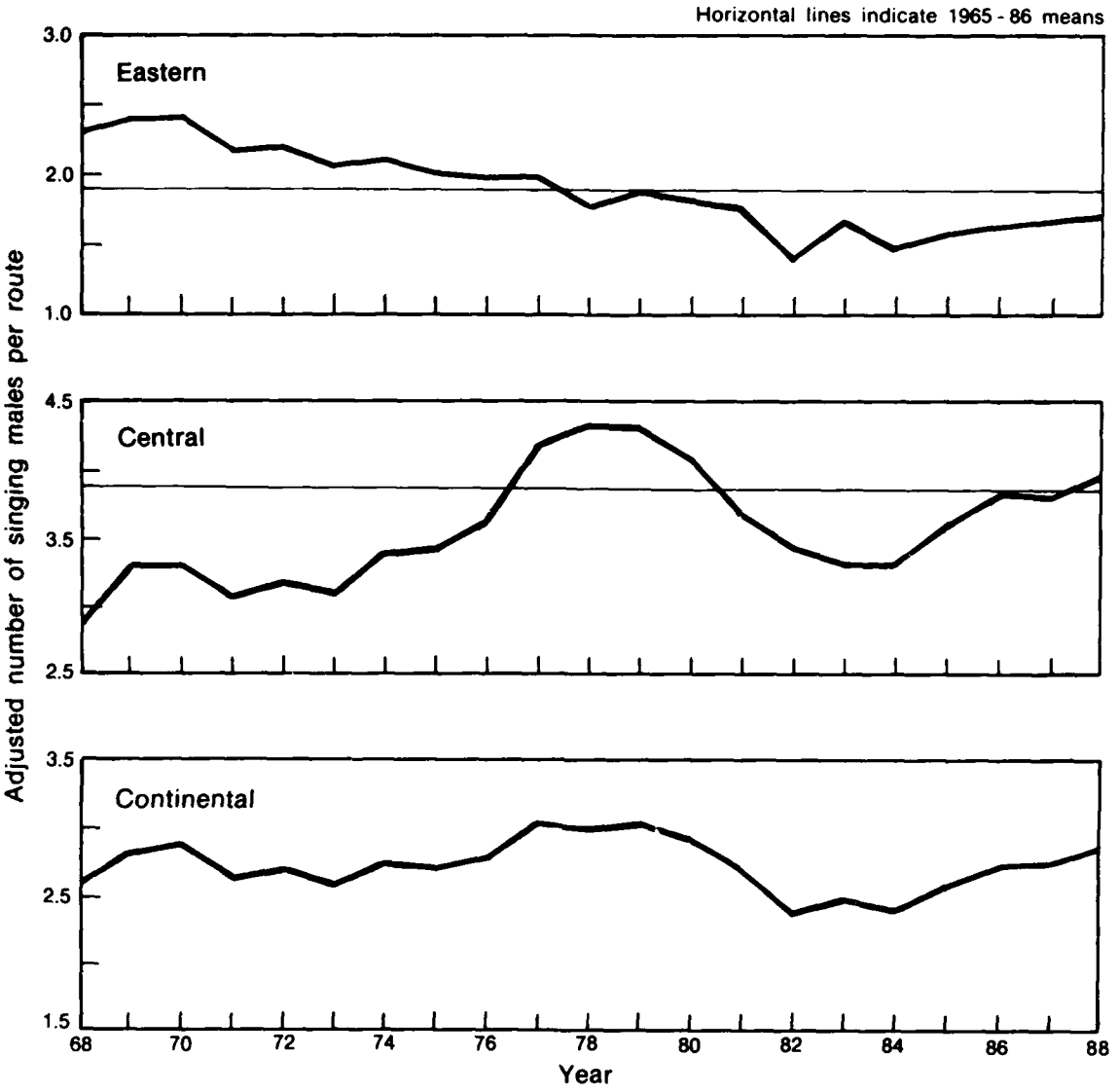


Figure 9. Indices of woodcock breeding success based on the annual Singing Ground Surveys for the Eastern and Central Regions and for the entire continental population (after Bortner 1988)

long-term mean (Bortner 1988). This population exhibited a steady increase from 1966 until the late 1970's but has fluctuated since then. Overall, the Central Region shows a significant long-term increase of 1.0% per year.

Owen (1977) used information from the Singing Ground Survey to calculate the number of breeding males per survey route. His highest estimates were 4 to 7 males per route in northern New England and across southern Canada.

The Lake States averaged from 2 to 4 breeding males per route while the mid- and southern-latitude states averaged less than 1 breeding male per route.

The wing survey used to estimate annual productivity is also a source of information on hunting success. The 1988 survey (Bortner 1988) has the average seasonal harvest (per hunter) at 10.7 birds in the Eastern Region and 14.6 birds in the Central Region. Both regions have exhibited a sharp decline since the early 1970's.

Local Densities

Estimates of local woodcock densities are not available although it is well known that, even in good habitat, numbers can vary from over 10 birds/ha (4/acre) to fewer than 1/ha (0.4/acre). Sheldon (1967) observed this variability in local populations and noted that woodcock density in a given area is unpredictable and that the birds may be scattered, concentrated, or absent, depending on the time of the year, the prevailing weather, or the condition of the habitat.

Flush rates (number of flushes per man-hour) provide insight into local population levels. Examples from various parts of the country include 1.7 in Michigan (Blankenship 1957), 1.5 in Pennsylvania (Liscinsky 1972), 1.6 in Georgia (Pursglove 1975), 1.3 in West Virginia (Goudy et al. 1970), 2.3 in Alabama (Causey 1981), and 1.6 in South Carolina (Ingram and Wood 1983). These estimates should be viewed with caution because they are based on the total time spent hunting and therefore may include search time spent in poor-quality habitat.

A good, although not quantitative, source of information on local population densities comes from observations of woodcock during migration or on the wintering grounds. During these periods, woodcock have often been observed in large concentrations. For example, Sheldon (1967) cited an instance of between 75 to 100 flushes on November 9, 1961, at Cape May, New Jersey, a major staging area during migration. He also reported that 86 birds were flushed in 3 hours in Michigan on October 29, 1959. Roberts (unpublished data) flushed 25 woodcock in 1.5 hours of intensive searching in a streamside covert of approximately 2 ha (4.9 acres) in western Mississippi on February 9, 1982. During spring migration, it is not uncommon to find 10 to 15 woodcock in coverts less than 0.5 ha (1.2 acre) in size. Concentrations such as these generally are not maintained for more than a few days.

One study does provide density estimates over a somewhat larger area. Dwyer et al. (1988) reported that summer densities on the Moosehorn National Wildlife Refuge in northeastern Maine ranged from 0.19 bird/ha (0.47/acre) to 0.25 bird/ha (0.62/acre) from 1977-1980. The refuge is 3,401 ha (8,404 acres) and contains areas of varying habitat quality. The authors noted that the area is typical of much of the Northeast and that their estimates may be used as a basis for comparison.

HABITAT REQUIREMENTS

Woodcock are closely associated with young, second-growth hardwoods, although they use, and in some cases require, other habitat types. Their needs include moist forested areas for diurnal cover and feeding, clearings or fields for nocturnal use, open areas with scattered brush for courtship displays by males, and dense stands of saplings for nesting and brood rearing.

Diurnal Cover

Diurnal habitat provides concealment and a source of food for woodcock from just before sunrise until dusk. Diurnal habitat is essential to both sexes and all ages of woodcock on both the breeding and wintering ranges. A lack of acceptable diurnal habitat is probably the factor most limiting to woodcock throughout much of the range.

Species composition. The plant associations that provide diurnal cover vary according to geographic location (Cade 1985). Woodcock probably do not select habitat based on specific tree or shrub species, but do tend to be associated with those species that reflect favorable structure, soil moisture, earthworm populations, etc. In the northern part of the range, woodcock are often found in stands of aspen (*Populus* spp.), birch (*Betula* spp.), or alder (*Alnus* spp.). Mendall and Aldous (1943), Sheldon (1967), Liscinsky (1972), Dunford and Owen (1973), Rabe (1977), and Gregg (1984) all reported one or more of these species as being the major components of diurnal cover. Other species may also be very important locally. Sheldon (1967) found that black locust (*Robinia pseudoacacia*) was the dominant woody species in coverts on Martha's Vineyard Island and that highbush blueberry (*Vaccinium atrococcum*) was dominant on Nantucket Island. There is evidence that species composition of diurnal cover in the North may vary from spring to fall (Mendall and Aldous

1943, Rabe 1977). Both studies found that use of alder thickets increased over aspen or deciduous forests as fall migration neared.

In the South, diurnal cover needs are met by a wide variety of forest types. Bottomland hardwoods are commonly used by woodcock during fall and winter (Glasgow 1958, Dyer and Hamilton 1977, Horton and Causey 1979, Roberts et al. 1984). Detailed descriptions of preferred bottomland sites have been presented only by Dyer and Hamilton (1977). They found a higher occurrence of sugarberry (*Celtis laevigata*), elm (*Ulmus* spp.), and boxelder (*Acer negundo*) on flush sites than on randomly selected ones. Other species of hardwoods that are attractive as diurnal cover include sweetgum (*Liquidambar styraciflua*), black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), eastern cottonwood (*Populus deltoides*), and oaks (*Quercus* spp.). Stands of red bay (*Persea borbonia*) growing along seeps or small streams (often referred to as bay galls) also provide excellent diurnal cover (Steve Paris, Wildlife Biologist, Fort Polk, Louisiana, pers. commun., 1987). Areas dominated by pines (*Pinus* spp.) may also be extensively used. Glasgow (1958), Kroll and Whiting (1977), and Johnson and Causey (1982) all reported high woodcock use of areas where pines were the dominant or codominant species in the overstory.

Structure. Habitat structure is one of the main factors influencing the suitability of diurnal cover. Sites must provide protective overhead cover but not be so dense at ground level to inhibit foraging. Acceptable habitat ranges from stands of saplings or small pole-sized trees to older stands composed of midsuccessional or mature trees. In older stands, saplings, shrubs, or woody vines that provide cover at ground level are an essential habitat component (Roberts, personal observation).

While there is a great deal of variability in the structure of habitats used as diurnal cover, it seems that woodcock prefer areas with moderate densities of saplings or shrubs and avoid habitats that are very dense or very open (Cade 1985). Rabe (1977) suggested that extremely dense areas may inhibit flight or increase predation, whereas open habitats do not provide adequate concealment. Habitat selection is influenced by a composite structure of the tree, sapling, shrub, and ground cover layers. Rabe (1977) referred to the sapling, shrub, and ground layers as the "understory" and felt that it was the single most important feature of woodcock habitat. Because of the interrelationships among various habitat components, there is a great deal of variability in the values of any single component. This variability is

evident in the quantitative information presented in the following sections. Figures 10 and 11 show good- and poor-quality diurnal cover in stands of different ages.

Overstory density. In Michigan, woodcock used coverts in which the sapling density ranged from approximately 2,000 to 12,000 stems/ha (810 to 4,860 stems/acre); tree density ranged from 50 to 890 ha (20 to 360/acre) (Rabe 1977). Horton and Causey (1979) found that in Alabama, woodcock tended to use bottomland hardwoods and mixed hardwood-pine forests more than other forest types. Average tree density was 741/ha (300/acre) in both forest types while sapling density was approximately 2,000/ha (810/acre) in bottomland hardwoods and 2,400/ha (970/acre) in mixed hardwood-pines. Hudgins et al. (1985) studied habitat preferences of radio-tagged woodcock in Pennsylvania and found that birds selected areas with an average of 8,250 saplings/ha (3,340/acre) and 410 pole-sized trees/ha (165/acre). Straw et al. (1986) worked in another area of central Pennsylvania and found that woodcock preferred areas with 5,200 to 7,400 saplings/ha (2,100 to 3,000/acre).

Shrub cover. Ranges of preferred shrub (woody vegetation with stems less than 2.5 cm (1 in.) in diameter) densities include 7,400 to 13,800 ha (3,000 to 5,580/acre) (Rabe 1977), 3,700 to 5,240/ha (1,500 to 2,120/acre) (Horton and Causey 1979), and 12,600 to over 86,000/ha (5,100 to over 34,800/acre) (Wenstrom 1973). Straw et al. (1986) measured shrub cover instead of stems per area. They found that woodcock preferred areas with greater than 32% cover of large shrubs.

Ground cover. Lincinsky (1972) stated that ideal woodcock cover should contain (approximately) 25% ground cover and 75% overstory cover, although most studies have reported somewhat denser ground cover in areas used by woodcock. In Quebec, Wishart and Bider (1976) found that ground cover was moderate ($\bar{x}$ = 46%) in good habitat, whereas poor coverts tended to be at the extremes. Woodcock studied by Rabe (1977) used sites in which the ground cover ranged from 33.2% to 64.5%. Horton and Causey (1979) found that the ground cover on "activity centers" averaged 47%.

Woody vines often compose part of the ground cover layer and in some areas may be a very significant influence on the suitability of a site for woodcock. Throughout southern bottomlands, species such as peppervine (*Ampelopsis arborea*), trumpet creeper (*Campsis radicans*), greenbriers (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), and grapes (*Vitis* spp.) are

Figure 10. Good-quality woodcock diurnal cover in sapling-dominated stand (top) and mature hardwood stand (bottom). Note presence of saplings and vines in the understory of mature stand. Both areas are in Mississippi

Figure 11. Poor-quality woodcock diurnal cover in pole-sized hardwood stand in Mississippi. Note open understory with absence of shrubs and saplings

common, and the cover they provide is highly attractive to wintering woodcock (Roberts, personal observation). Trumpet creeper and the greenbriers are particularly desirable, as they may form dense, protective tangles while remaining open at ground level.

Distribution of diurnal cover. How cover is distributed is a very important aspect of habitat selection by woodcock. Liscinsky (1972) noted that whenever stands were broken up into smaller units, woodcock use was more evenly distributed. He also found greater use of coverts that were scattered over the terrain (e.g., along both stream bottoms and on adjacent slopes) and concluded that under such circumstances, woodcock can take advantage of changing site conditions brought on by seasonal weather changes. Sheldon (1967) also felt that habitat diversity was beneficial to woodcock. He described the most productive covert that he hunted in Maine as being "an ideal juxtaposition of young alder, apple (*Malus* spp.), aspen, gray birch (*Betula populifolia*), and white birch (*B. papyrifera*), sprinkled with young white pines

(*Pinus strobus*) and broken by small openings." In the Northeast, old farms reverting to forests often contain a diversity of cover types due to differences in their prior land uses and varying chronology of abandonment (Sepik et al. 1981). These areas provide some of the best habitat in the Northeast (Owen 1977) and have contributed significantly to the acreages of woodcock habitat available during the past several decades. However, the amount of land reverting to forests has declined and is expected to continue to do so (Coulter and Baird 1982).

Nocturnal Cover

Woodcock often abandon forested habitats at twilight and fly into openings (called summer fields in the North) where they remain until just before dawn. Often these openings are the same ones used as singing grounds in the spring. This daily change in habitat has long been observed on the wintering grounds (Mendall and Aldous 1943, Glasgow 1958), while the nocturnal use of openings on the northern breeding grounds was first reported by Sheldon (1961). Figure 12 shows typical nocturnal roosting cover in Michigan (summer) and Mississippi (winter).

Breeding range. Sheldon (1967) described 4 fields that were used as nocturnal sites on his Massachusetts study area. All were covered by grasses or shrubs and were bordered by trees or shrubs less than 6.1 m (20 ft) tall. The dominant vegetation included low-bush blueberry (*Vaccinium angustifolium*), oak and chestnut (*Castenea* spp.) sprouts, and sweet fern (*Comptonia peregrina*). Krohn (1971) described 2 abandoned fields that he studied intensively as having a cover of grasses, hawkweeds (*Hieracium* spp.), and a variety of woody species such as meadow-sweet (*Spiraea latifolia*) and sweet-fern. He noted that woodcock most frequently used areas of the fields where low cover was interspersed with taller and denser cover. Dunford and Owen (1973) found that radio-tracked immature woodcock in Maine used several different types of openings. Abandoned fields, pastures, and Christmas tree plantations received the heaviest use, although powerline rights-of-way, woods roads, bogs, and cutover forests were also mentioned. Abandoned fields were characterized by scattered clumps of shrubs with variable ground cover, primarily grasses. Pastures were usually covered with short, dense grass and contained little shrubby vegetation.

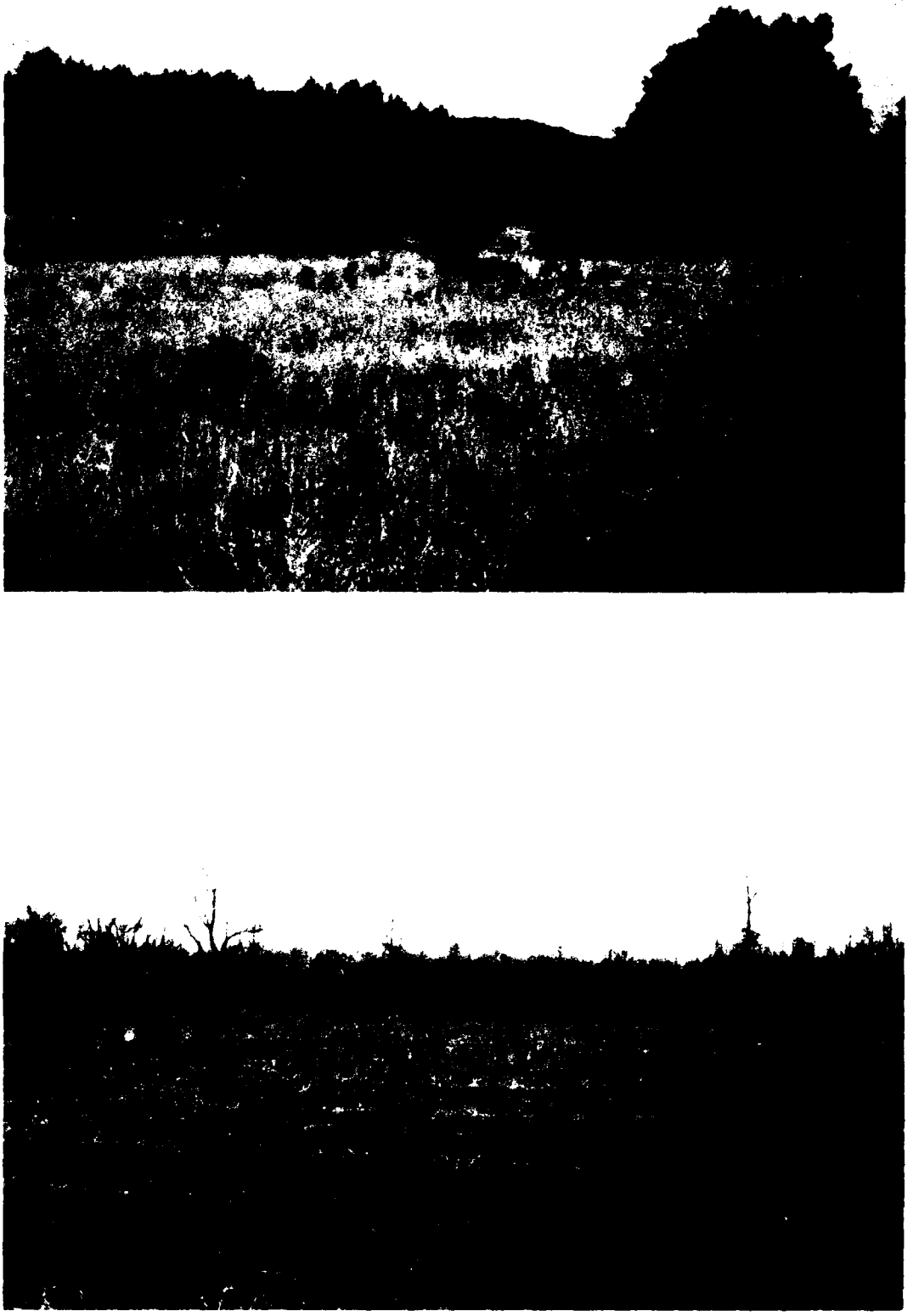


Figure 12. Brushy field used as nocturnal roosting habitat in Michigan (top), and harvested soybean field used in Mississippi (bottom)

Whitcomb (1974) studied an island population in Lake Michigan and found that vegetation on summer fields was quite variable. He described the typical flush site as consisting of "short, sparse herbaceous plants interspersed with shrubs and small trees." Grasses, wild strawberry (*Fragaria ovalis*), and St. Johnswort (*Hypericum* spp.) were the most commonly occurring herbaceous species. Wild rose (*Rosa* spp.), red-osier dogwood (*Cornus stolonifera*), apple, staghorn sumac (*Rhus typhina*), and pin cherry (*Prunus pensylvanica*) were among the common woody species.

Woodcock continue to use nocturnal fields during migration. Krohn et al. (1977) conducted banding operations on fields at Cape May, New Jersey, where large numbers of woodcock concentrate during fall. Most captures were made in abandoned fields, lightly grazed pastures, and alfalfa fields. Fields with dense grass cover and pastures that were heavily grazed were avoided.

Wintering grounds. On the wintering grounds, nocturnal cover in Louisiana bottomlands ranged from pastures to fallow fields to agricultural fields planted in corn, cotton, and sugar cane (Glasgow 1958). Two common pasture species were Bermudagrass (*Cynodon dactylon*) and dallis grass (*Paspalum dilitatum*). Most pastures also contained a number of herbaceous species, such as Yankeeweed (*Eupatorium capillifolium*), cocklebur (*Xanthium italicum*), smartweed (*Polygonum* spp.), and fleabane (*Erigeron* spp.), as well as scattered clumps of shrubs and small trees. Agricultural fields were used extensively after crops had been harvested and only the cutoff stalks were left standing. In the upland portions of the state, fields were characterized by carpetgrass (*Axonopus affinis*) and bitterweed (*Helenium tenuifolium*) with goatweed (*Croton capitatus*), common lespedeza (*Lespedeza striata*), blueberry (*Vaccinium* spp.), and brambles (*Rubus* spp.); a variety of other species were also present.

Connors and Doerr (1982) compared woodcock use of 4 types of agricultural fields in coastal North Carolina. Woodcock exhibited a strong preference for untilled soybean fields over fields planted to winter wheat and both tilled and untilled corn fields. They seldom used tilled fields and never used fields planted to winter wheat. The authors felt that the furrow-row complex of untilled soybean fields afforded the birds protection as well as access to food. Horton and Causey (1979) reported that woodcock wintering in Alabama also frequently moved from diurnal cover into openings. Of the reliable locations they had on radio-tracked birds, 44% were in openings while 56% were in forested areas. No description of nocturnal habitat was given.

A shift from diurnal habitat does not necessarily occur each day; Sheldon (1967), Whitcomb (1974), and Wishart and Bider (1976) all noted decreases in summer field activity during August. The birds apparently remain in forested cover throughout the 24-hour period, possibly in response to the physiological stresses of molt that occur about this time of year (Wishart and Bider 1976). Other studies have also confirmed that, on the wintering grounds, woodcock may not move to fields each night (Horton and Causey 1979; Roberts, personal observation). In Mississippi, this behavior has been associated with very cold, windy conditions, suggesting that energy conservation may play a role in influencing nocturnal movements. Use also appears to vary according to age and sex (Krohn 1971, Horton and Causey 1979, Conners and Doerr 1982), as immature males are most often found using fields.

Singing Grounds

The male woodcock's breeding territory, the singing ground (Fig. 13), is typically a relatively open field containing scattered brush, small trees, or shrubs. Although natural or man-made clearings are most commonly used, Liscinsky (1972) reported that woodcock in Pennsylvania have been observed performing courtship flights in pastures, cultivated fields, baseball diamonds, lawns, and garden plots. In the South, woodcock often establish territories in agricultural fields and pastures in addition to old fields and forest clearings (Roberts, personal observation). Many of the areas, such as pastures and cultivated fields, are almost completely devoid of woody vegetation. Young pine plantations are widely used as singing grounds in eastern Texas (Whiting and Boggus 1982) and in Tennessee and Mississippi (Roberts, personal observation).

Woodcock use openings of all sizes as singing grounds. For example, Sheldon (1967) observed males courting from areas as small as 9.3 sq m (100 sq ft) to as large as several thousand square feet. However, there is evidence that smaller openings may be preferred. Wishart and Bider (1976) found that openings used as singing grounds averaged 0.4 ha (1.0 acre) with a range of 0.04 to 1.5 ha (0.1 to 3.6 acres). In New Brunswick, densities of singing males were higher on clearcuts smaller than 20 ha (49.4 acres) than on larger ones (Nicholson et al. 1977). Gutzwiller and Wakeley (1982) also found that smaller openings were used more frequently but suggested that the

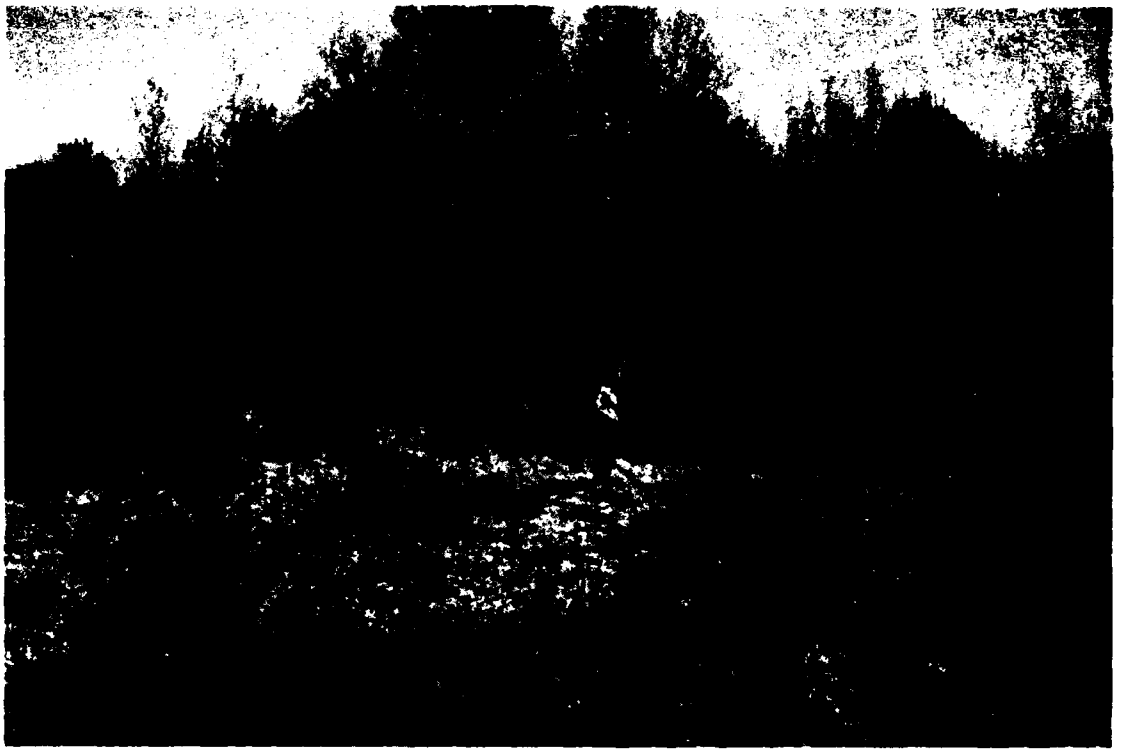


Figure 13. A typical woodcock singing ground (Pennsylvania)

difference may have been due to the associated vegetation structure rather than to size per se.

Many factors influence the suitability of a site as a singing ground, but three seem to be particularly important. These are (a) structure of the vegetation, (b) height of the vegetation surrounding the singing ground, (c) and proximity to diurnal cover.

Vegetation structure. Most of the research on the structural characteristics of singing grounds has shown that areas with short shrubs or trees in moderate densities are preferred. Sheldon (1967) noted that courtship occurred only in areas with scattered woody plants 0.3 to 0.6 m (1 to 2 ft) high. Wishart and Bider (1976) found some woody plants on all the singing grounds they studied in southwestern Quebec; 89% of the fields had from 4% to 30% cover of woody vegetation greater than 0.9 m (3.0 ft) tall. Height of cover can apparently limit the attractiveness of a field, as Wishart and Bider (1976) found that trees over 4.6 m (15 ft) tall never exceeded 8% of the total cover.

Although the presence of woody species is desirable on singing grounds, the variability in percent cover among sites can be quite large. For example, Maxfield (1961) found that cover of woody plants on Massachusetts singing grounds ranged from 10% to 90%. In central Pennsylvania, Gutzwiller and Wakeley (1982) determined that shrub density, along with edge height and opening size, explained much of the variation in an index of site use. Shrub densities ranged from over 2,000 to nearly 19,000 stems/ha (810 to 7,700 stems/acre) with a mean of 8,634 stems/ha (3,500/acre). The authors suggested that shrubby areas may limit avian predation on singing males by providing protection from aerial attacks.

Moderately dense herbaceous cover is often found on singing grounds. For example, Gutzwiller et al. (1983) and Kinsley et al. (1982) found that herbaceous cover on singing grounds in Pennsylvania averaged 63.5% and 72.0%, respectively. However, it is not clear whether dense ground cover is preferred since courting males often alight and conduct the ground portion of their display from bare areas (Sheldon 1967).

Height of surrounding vegetation. An essential requirement for a singing ground is a "get away" route for the male at the beginning of his aerial display (Sheldon 1967). Since the first several meters of the flight are low to the ground, tall trees around the perimeter of the area impede courtship and may severely reduce the attractiveness of the site. Maxfield (1961) found that the height of surrounding trees tolerated by woodcock varied directly with the size of the singing ground. Based on his work, fields approximately 1 ha (2.5 acres) in size should not be bordered by trees taller than 15 m (50 ft). Very small sites should have borders no taller than approximately 2 m (7 ft). The importance of a low border has also been documented by Lambert and Barclay (1975), Wishart and Bider (1976), and Gutzwiller and Wakeley (1982), although information on critical heights was not given.

Proximity to diurnal cover. Singing grounds are normally located close to diurnal cover. Mendall and Aldous (1943) found 24 of 29 singing grounds less than 91 m (100 yd) from diurnal cover. Sheldon (1967) reported that only 2 of 55 diurnal coverts were more than 402 m (440 yd) from a singing ground, 16 were immediately adjacent, and 33 were less than 183 m (200 yd) away. All 18 singing grounds studied by Wishart and Bider (1976) were adjacent to diurnal cover. Kinsley et al. (1982) found the average distance separating

singing grounds from diurnal cover to be 91 m (100 yd). Hudgins et al. (1985) reported that the median distance that radio-tracked birds moved between diurnal cover and singing grounds was 362 m (400 yd), with a range of 50 to 964 m (55 to 1,055 yd).

Although these studies have shown that singing grounds are normally close to diurnal cover, it cannot be assumed that an individual male will always use the nearest available singing ground. Hudgins et al. (1985) noted instances of males not using diurnal cover adjacent to their singing grounds and speculated that site quality or other woodcock may have influenced site selection.

Other factors. A study by Dwyer et al. (1988) suggested that proximity to nesting cover may be more significant than previously thought in influencing the males' selection of singing grounds. They found that older, more experienced males dominated the display areas adjacent to better (presumably) nesting cover early in the breeding season when most nesting occurs. From this, they theorized that male woodcock have evolved the ability to determine which singing grounds are surrounded by the best available nesting cover and that females are attracted to these areas. Additional research will be needed to verify their hypothesis.

The composition of the vegetation does not appear to significantly influence the use of a site. The makeup of the woody plant communities reported by researchers from different parts of the range (Blankenship 1957, Sheldon 1967, Wishart and Bider 1976, Gutzwiller et al. 1983) varied considerably although structural characteristics were similar. The herbaceous community was also quite variable. These findings are logical, as plants are normally dormant during much of the courtship period. A species list would likely be very similar to a list developed for nocturnal fields. In general, it can be said that singing grounds are vegetated by early successional species typical of that particular region of the country.

Nesting Cover

The woodcock's nest is a shallow cuplike depression often positioned at the base of a small tree (Sheldon 1967) or shrub (Gregg 1984). Although sometimes located in wet or swampy areas, the nest site itself is generally in a well-drained location (Mendall and Aldous 1943, Bourgeois 1977).

Woodcock normally construct their nests in young stands of hardwoods or mixed hardwoods and conifers (Mendall and Aldous 1943, Bourgeois 1977, Roboski

and Causey 1981); however, they are not strongly selective and make use of a wide range of conditions for nesting (Mendall and Aldous 1943, Sheldon 1967, Liscinsky 1972, Coon et al. 1982). For example, of 128 nest sites in Maine categorized by Mendall and Aldous (1943), several distinctly different habitat types were used. Forty-four percent of the nests were in mixed-growth forests composed mainly of birch, aspen, spruce (*Picea* spp.), and fir (*Abies* spp.). Alder or alder-willow stands were next in importance with 26%, while mixed hardwoods of birch, aspen, and maple (*Acer* spp.) accounted for 21%. Brushland and cleared land were 4% and 5%, respectively. Sheldon (1967) reported that woodcock nests in Massachusetts were found in abandoned fields, conifer plantations, brushy areas, mixed forests of different ages, and blueberry fields. Kletzly (1976) stated that woodcock in West Virginia nested in pine plantations, abandoned fields, fence rows adjacent to cover, alder and aspen stands, and young, second-growth timber. Figure 14 shows typical nesting cover.

Vegetation structure is one of the key habitat features influencing use by nesting females. Mendall and Aldous (1943) felt that young, open stands of second-growth hardwoods between 15 and 20 years of age provided the best nesting cover. Quantitative studies have supported their conclusion.

Figure 14. Woodcock nesting cover in Tennessee

Bourgeois (1977) found that nesting habitat in Michigan was composed primarily of early successional forests dominated by saplings and seedlings. Average tree density was 2,161 stems/ha (875 stems/acre) with a basal area of 8.6 sq m/ha (37.5 sq ft/acre). Coon et al. (1982) found that shrub stem density was the most important habitat variable that distinguished nest sites from randomly selected sites nearby. They found an average of 394 stems in a 0.008-ha (0.02-acre) plot surrounding the nest; this converts to 49,250 stems/ha (19,900 stems/acre).

Roboski and Causey (1981) also thought that structure, particularly stem density in the lower strata, was a key factor influencing nest site selection in Alabama. The density of woody seedlings and shrubs on their study sites averaged 20,630 stems/ha (8,350/acre) while the tree density was 436 stems/ha (175/acre). Average diameter at breast height of trees was 22 cm (8.7 in.) with a range of 10 to 92 cm (3.9 to 36.3 in.). These values are characteristic of open-growth, intermediate-aged poletimber or maturing sawtimber. This suggests that nesting habitat in Alabama may be somewhat different from that in more northern parts of the range.

Nests are commonly located close to an opening or edge. The average distances to an opening reported by several researchers include 7 m (23 ft) (Bourgeois 1977), 60 m (197 ft) (Roboski and Causey 1981), 9 m (30 ft) (Coon et al. 1982), and 16 m (54 ft) (Gregg 1984). The tendency to nest near openings may reflect plant density and structure more than the spatial aspects per se. Edge vegetation normally receives more sunlight and tends to be brushy, resulting in structural conditions preferred for nesting cover.

The proximity to a singing ground also has been suggested as a factor in determining use by female woodcock. Mendall and Aldous (1943) found that the average distance between nests and the nearest singing ground was 105 m (345 ft); Gregg (1984) reported an average distance of 119 m (390 ft). Dwyer et al. (1988) highlighted the relationship between nesting cover and singing grounds but presented no data on actual distances.

Brood Cover

Brood cover is similar to nesting cover but tends to be somewhat denser. Mendall and Aldous (1943) noted that "the cover where the broods are usually found does not differ materially in type from that used for nesting." They did state, however, that brood cover tended to contain very dense ground

vegetation. Bourgeois (1977) found broods using areas where the vegetation was significantly different from that used for nesting. The mean tree density and basal area of brood sites were nearly double those of nest sites--3,923/ha (1,588/acre) and 16.5 sq m/ha (72 sq ft/acre), respectively. Wenstrom (1974), Sheldon (1967), and Bourgeois (1977) all reported that broods are often found in poorly drained areas. Wenstrom (1974) suggested that these areas provided increased foraging opportunity due to the abundance of litter insects present. Figure 15 shows typical brood cover.

FOOD HABITS AND FEEDING

The woodcock feeds on invertebrates by probing in the soil with its long bill. The bill is flexible and can be opened near the tip even when it is beneath the ground surface. The tip contains numerous nerve endings, presumably to aid in detecting movement of prey items (Sheldon 1967).

The woodcock is an opportunist and consumes a variety of soil invertebrates (Sheldon 1967), but most studies show that earthworms (Lumbricidae) comprise the major portion of the diet. Insect larvae, particularly those of

Figure 15. Woodcock brood cover in Tennessee

beetles (Coleoptera) and flies (Diptera), generally rank second in importance. Caterpillars (Lepidoptera) and centipedes (Chilopoda) have been reported as important in some studies. Ants (Hymenoptera), spiders (Arachnida), and caddisflies (Trichoptera) are occasionally eaten, but they and other animal foods normally make up only a very small percentage of the total diet. Table 2 lists the major items identified in four comprehensive food habits studies (Sperry 1940, Sheldon 1967, Krohn 1970, Miller and Causey 1985).

Only three species of earthworms are commonly eaten by woodcock in the northern portions of the range (Reynolds 1977). These include *Aporrectodea tuberculata*, *Dendrobaena octaedra*, and *Lumbricus rubellus*. Reynolds et al. (1977) found that diurnal coverts favored by woodcock in Maine contained the highest lumbricid populations, presumably because the areas provided favorable conditions for earthworms. Abundant leaf litter, soil moisture between 15% and 80%, and soil temperatures between 10° and 18° C (50° and 65° F) are the conditions that are considered optimal for earthworms. Reynolds (1977) noted that the earthworm species identified in his study are not distributed throughout the woodcock's range and that there would be differences in food

Table 2. Percent volume and frequency of occurrence of major food items found in stomachs* of American woodcock

	Location and (Author(s)) of Study							
	United States and Canada (Sperry)		Massachusetts (Sheldon)		Maine (Krohn)		Alabama (Miller and Causey*)	
Food Item	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.
Lumbricidae	60.7	--	30.0	53.3	68.0	64.0	71.0	81.0
Coleoptera	5.5	--	38.7	--	15.0	72.0	11.0	22.0
Diptera	6.1	--	15.3	--	1.0	25.0	7.0	19.0
Lepidoptera	3.2	--	14.7	--	Tr**	3.0	--	--
Chilopoda	--	--	--	--	--	--	16.0	--
Plant	10.0	80.0	--	--	--	--	5.0	--

* Data based on contents of proventriculus and esophagus only.
** Trace detected.

habits on the wintering range. To date, no studies have been conducted to identify earthworms used by woodcock in the Southern States.

Plant items are frequently found in woodcock stomachs although they generally account for only a small percentage of the total volume (Table 2). For example, although Sperry (1940) found plant material in 80% of the 261 birds he examined, it constituted only about 10% of the total diet. Only Miller (1957) reported a significant amount of plant material (60% by volume from 115 birds). Interpretation of this unusual finding is difficult. In most cases, it is not possible to tell whether the plant items were ingested intentionally, whether they were accidentally picked up while probing for earthworms or other animals, or whether they had been ingested by earthworms before they in turn were eaten. Sperry (1940) felt that the latter explanation was often the case. However, Sperry did find some stomachs with enough material present in sufficient quantity to assume that the birds had purposely eaten it. Some of the more important items were seeds of sedges (*Carex* spp.), violets (*Viola* spp.), alder, and blackberries and raspberries (*Rubus* spp.). Miller (1957) also reported finding seeds of sedges and blackberries.

Woodcock consume a considerable quantity of food each day. Sheldon (1967) reported that a captive flock he maintained one summer ate an average of 150 g (5.3 oz) of earthworms each day. This was approximately the same as the body weight of the birds. Liscinsky (1972) noted that 2 captive woodcock consumed an average of 61 g (2.1 oz) of earthworms each day for 12 days. This was an insufficient amount, as both birds experienced a weight loss of nearly 30%. Mendall and Aldous (1943) mentioned reports of captive woodcock eating more than their body weight in earthworms a day.

Feeding apparently occurs at intervals throughout a 24-hour period, but because woodcock are difficult to observe, our knowledge of feeding behavior is incomplete. Pettingill (1936), Mendall and Aldous (1943), and Glasgow (1958) all noted that woodcock fed at night, mostly during late evening or early morning. Sheldon (1967) observed captive woodcock and found that they fed at or just before dawn, at noon, and again in late evening. The heaviest feeding occurred at noon, with little feeding at night.

Research has shown that feeding periods may vary depending on the time of year. Krohn (1970) discovered that little night feeding occurred on fields in Maine during the summer. His findings were corroborated by Wishart and Bider (1976) and Dunford and Owen (1973); the latter researchers speculated that

fields simply act as roosting sites and afford protection from predators. In contrast to Krohn's findings in Maine, Krohn et al. (1977) observed migrating woodcock at Cape May, New Jersey, feeding nocturnally in fields and suggested that the stresses of migration and the availability of fertile fields were responsible for the difference in behavior.

Rabe et al. (1983) reported that woodcock may select potential feeding areas based on soil color. Darker colors, which were favored by woodcock, presumably indicated desirable levels of organic matter and soil moisture.

MANAGEMENT

Management of woodcock habitat has, to date, centered around manipulation of forest lands in the northern portions of the range. Little attention has been devoted to management on the wintering grounds, although much of the information in this section has application throughout the range. Efforts in the North have focused on developing or maintaining diurnal cover, singing grounds, and fields or other openings suitable for use as nocturnal cover. Many researchers have been involved with these efforts, and there has been a steady advancement of our knowledge of habitat management for woodcock. Liscinsky (1972), Sepik et al. (1981), and Gullion (1984) provide detailed guidelines on management of forest habitat and should be read by persons interested not only in woodcock, but also ruffed grouse.

A comprehensive woodcock management plan should provide habitat for all the woodcock's needs. Four distinctly different types of habitat are needed (Sepik et al. 1981); these include (a) openings for courtship, (b) young, second-growth hardwoods near openings for nesting and brood rearing, (c) alders or dense stands of hardwoods for diurnal feeding cover, and (d) large fields for roosting at night. High-quality aerial photographs provide a ready means of delineating these and are valuable in the many phases of developing a management plan.

Spatial Considerations

When woodcock management is undertaken, the spatial relationships of the various habitats on an area have to be considered. Sepik et al. (1981) recommended that singing grounds be located close to diurnal cover and no more than 0.8 km (0.5 mile) away. Because woodcock tend to nest near openings (Bourgeois 1977, Coon et al. 1982, Gregg 1984) and singing grounds (Mendall

and Aldous 1943, Gregg 1984), establishing singing grounds in cover that is suitable for these needs is desirable. Night roosting sites should also be within 0.8 km (0.5 mile) of diurnal cover. Figure 16 illustrates an ideal arrangement of cover types on a 120-ha (300-acre) farm.

Timber Management

Some of the best woodcock diurnal cover consists of young stands of mixed hardwoods, aspen, or alder. A problem for the wildlife manager is that forests are continually undergoing change and eventually reach a state that is no longer favorable for woodcock. Sheldon (1967) stated that most coverts pass from excellent habitat to overgrown woodland in 25 years. With some fast-growing species such as alder, the time that an area remains in an acceptable stage is greatly reduced (Mendall and Aldous 1943). For example, Weeden (1955) found that alder stands averaging only slightly older than 11 years were no longer suitable for use by woodcock. Thus, one of the major management goals for ensuring adequate diurnal cover is to maintain a sufficient

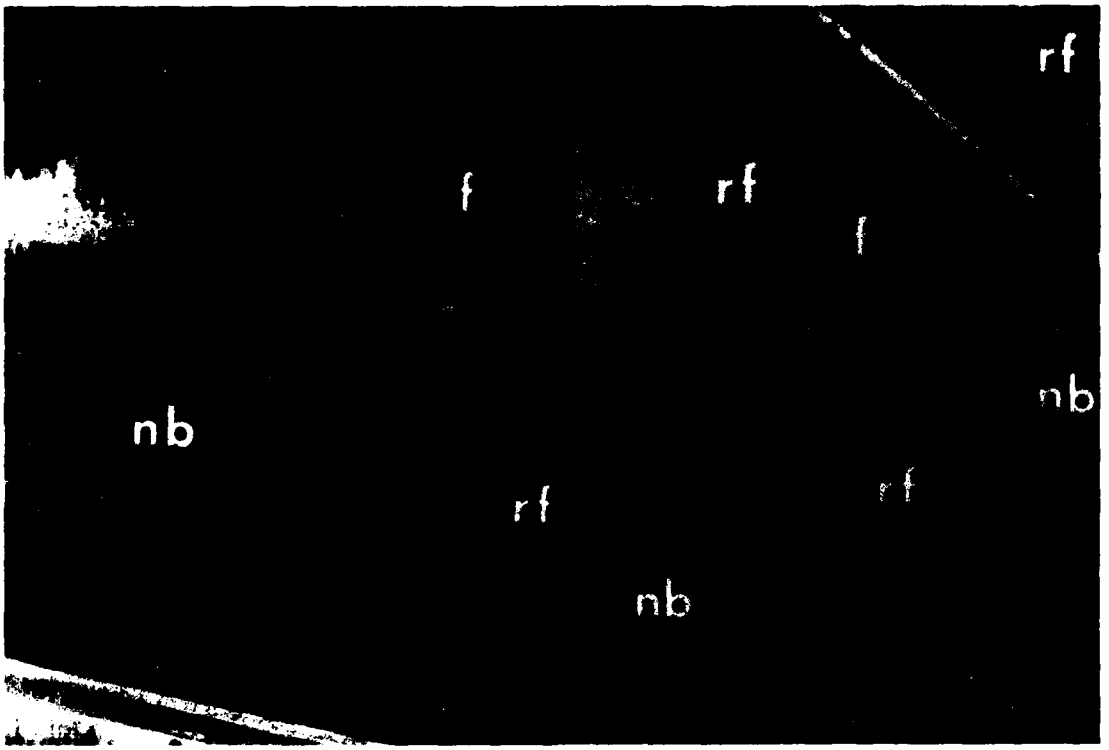


Figure 16. Aerial photo showing ideal spatial relationship of woodcock cover needs (from Sepik et al. 1981) (f = diurnal cover and feeding areas, nb = nesting/brood cover, rf = roosting fields)

amount of forest land in an early successional stage. This may involve creation of new forests or setting back succession of older forests.

One of the main forest management techniques that has proven successful for maintaining early successional conditions is clearcutting. Cutting was first recommended as a woodcock management technique at the Moosehorn National Wildlife Refuge in Maine and was tried on an experimental basis in the early 1940's (Sheldon 1967). Most of the work on forest management has emphasized alder and aspen because of their value as diurnal cover, but many other hardwoods and softwoods respond similarly to treatment and can provide excellent diurnal cover. However, northern hardwoods often grow on dry middle and upper slopes, which are of limited value as woodcock habitat (Liscinsky 1972). Thus, management of northern hardwoods for woodcock is most appropriate in valleys and on lower slopes. There, clearcutting favors intolerant species such as red maple (*Acer rubrum*) and cherry (*Prunus* spp.) over sugar maple (*A. saccharum*), beech (*Fagus grandifolia*), and birch (Liscinsky 1972). As with any woodcock management effort, soil fertility, drainage characteristics, and other site factors should be considered before work is initiated.

Alder is one of the major species for which detailed cutting recommendations have been developed. In stands that are only slightly overmature (few dead stems or other invading tree species), Sepik et al. (1981) recommended cutting strips 21 m (70 ft) wide. Current recommendations are to use 30-m (100-ft) strips (Sepik, pers. commun.). These strips should be separated by uncut strips 85 m (280 ft) wide. It is desirable to cut strips across a moisture gradient to provide cover of varying densities and to ensure a constant supply of earthworms throughout the summer. New strips should be cut adjacent to the old strips every 4 to 5 years. In stands older than 20 years, strips should be cut every 2 years. If alders are only a small, scattered portion of the understory, clearcutting should be considered. Liscinsky (1972) also recommended clearcutting alder but made no recommendations on the width of strips. He suggested that the operation be conducted during winter. A complete rotation should take about 20 (Sepik et al. 1981) or 25 (Liscinsky 1972) years.

Aspen is another species that responds favorably to clearcutting. Aspens grow as clones (by vegetative regeneration from the roots of a common, seedling ancestor). When a stand is cut or destroyed by fire, a profusion of sprouts, or suckers (up to 173,000/ha (70,000/acre)), develops from the roots

(Gullion 1984). These early stands are too dense for woodcock, but in a few years they develop into good nesting and brood habitat (Sepik et al. 1981) and later into excellent diurnal cover. Gullion (1984) provided a comprehensive treatment of aspen management primarily for ruffed grouse, although most of the suggested treatments also improve habitat quality for woodcock. Gullion suggested cutting in 4- to 8-ha (10- to 20-acre) blocks, depending on constraints of the project (for example, larger clearcuts are acceptable if commercial timber is an interest). Four age classes on a 10-year cutting cycle are recommended. For maintaining brood cover in lowland areas, cuts should be made at 5- to 7-year intervals. Liscinsky (1972) recommended cutting aspen during the dormant season to maximize resprouting. Burning the slash can result in an increase in sprouting (Sepik et al. 1981, Gullion 1984).

In addition to furnishing high-quality diurnal cover, timber harvesting also provides woodcock with open areas that serve as singing grounds and night roosting fields. Areas that are cleared through timber harvesting (or by bush-hogging or bulldozing if timber is not of commercial size or quality) have been demonstrated to significantly increase woodcock use of areas where openings are in short supply. In one of the first efforts at managing forests for woodcock, Mendall and Aldous (1943) reported significant use of artificial singing grounds created at Moosehorn in the late 1930's. Similar results have been reported in other experimental situations (Sepik et al. 1977, Bennett et al. 1982) and also in areas where commercial harvesting is carried out (Nicholson et al. 1977). Commercial timber lands also serve as singing grounds in the Southern States. Roberts (1978), Pace and Wood (1979), Roboski and Causey (1981), and Whiting and Boggus (1982) noted instances of male woodcock performing courtship flights in young pine plantations.

Sepik et al. (1981) recommended that clearings established as singing grounds in wooded areas be at least 0.2 ha (0.5 acre) in areas where trees are over 7.6 m (25 ft) tall. Openings with shorter surrounding vegetation can be as small as 0.1 ha (0.25 acre). Where possible, the openings should be rectangular and face to the south. Slash should be removed. Larger clearings should be created if establishment of night roosting sites is the objective. Sepik et al. (1981) recommended that roosting fields be at least 1.2 ha (3 acres) in size.

Figure 17 shows a management plan for a 36-ha (90-acre) farm. The plan is designed to provide a small economic return in addition to maintaining

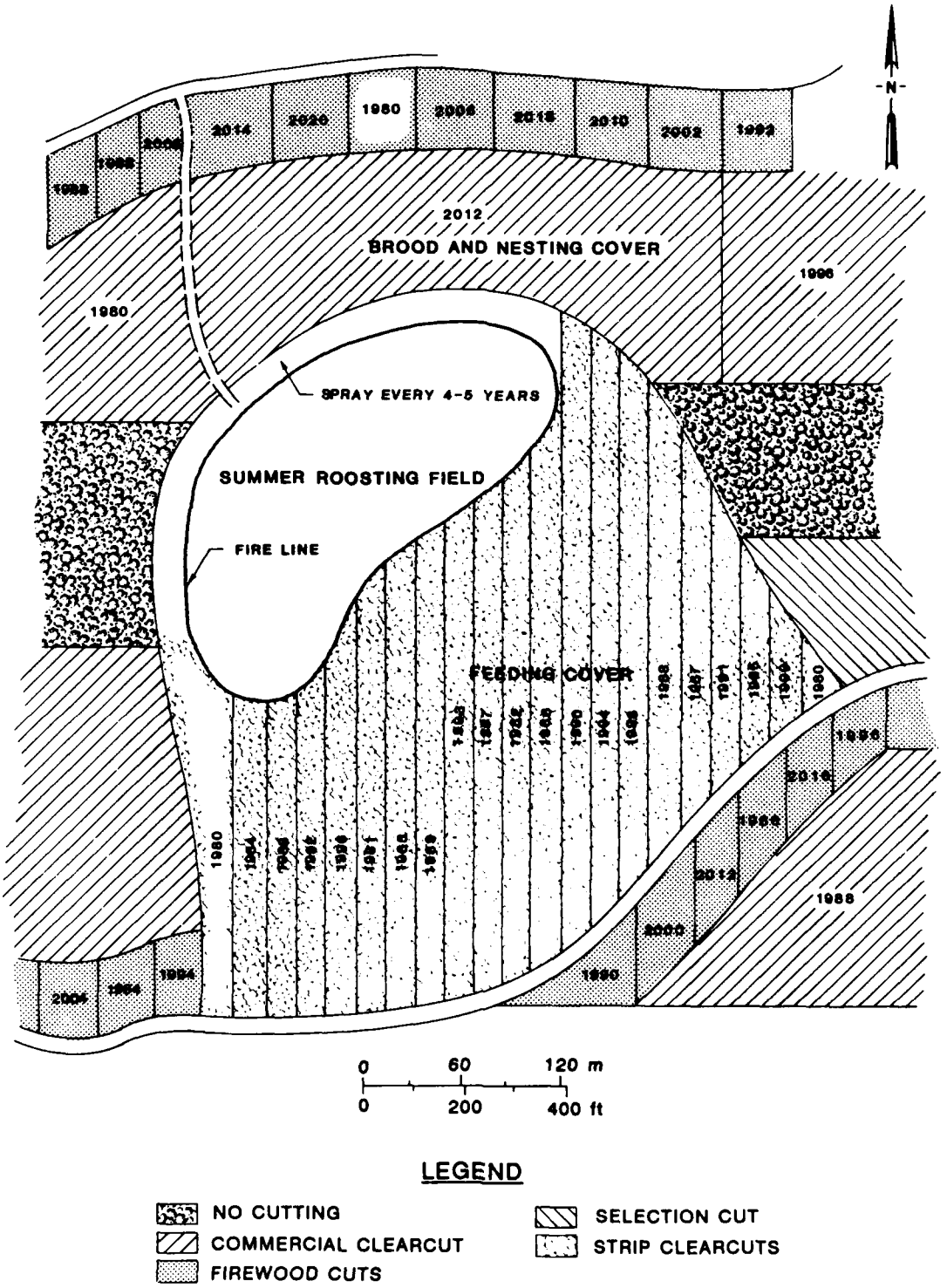


Figure 17. Diagram showing timber cutting rotation designed to provide woodcock diurnal feeding cover, nocturnal cover, and singing grounds (after Sepik et al. 1981)

high-quality woodcock habitat. Diurnal feeding cover will be provided by clearcutting strips through lowland alders. Nesting and brood cover will be maintained in small commercial clearcuts in hardwood-dominated stands. Singing grounds will be provided primarily by the small firewood cuts, although other openings may also be used. An old field near the center of the property will be mowed periodically to maintain it as a nocturnal roosting site.

Burning and Mowing

Burning provides the woodcock manager with a valuable and generally inexpensive way of enhancing diurnal cover and maintaining singing grounds and roosting areas. Stands of aspen can be burned to kill the above-ground stems and encourage regeneration of diurnal cover (Gullion 1984). If timber is commercially valuable, clearcutting prior to burning can achieve the same effects. Burning should be done in spring or fall, preferably before the second growing season after harvest. Mendall and Aldous (1943) also recommended the use of fire along with cutting to encourage growth of gray birch and aspen.

The burning of mature pine stands in the South has been shown to increase diurnal use by woodcock (Johnson and Causey 1982). They found that stands burned 1 year prior to the study and during the winter of the study received the highest use. They speculated that ground cover density was more favorable in the recently burned areas. If controlled burning is employed as a woodcock management practice in the South, care should be taken to ensure that nesting sites are not impacted, since nesting occurs during the optimum burning period.

Fire can also be used to impede succession on clearings used as singing grounds and roosting sites. Singing grounds and summer roosting fields can be maintained by burning every 2 years to eliminate invading woody species (Sepik et al. 1981). Burning should be done in late winter or early spring (depending on latitude) to prevent destruction of nests that might be located around the perimeter. Mowing the preceding fall is suggested to increase the amount of fuel on the ground. Glasgow (1958) reported that woodcock are attracted to burned fields in Louisiana; thus, it is likely that burning will also improve conditions on roosting fields in the South.

Mowing or bush-hogging can be used to maintain diurnal cover, singing grounds, and roosting fields where woody vegetation has not become too dense

or tall. Another mechanical technique involves the use of a bulldozer with a shear blade. Gullion (1984) stated that this approach was very effective for regenerating aspen stands. With aspen, care should be taken to minimize root disturbance.

Planting

If suitable vegetative cover is absent, planting of desirable species can be an effective management technique. Liscinsky (1972) conducted extensive investigations into planting alder and a variety of shrub species for woodcock. He found that alder could be successfully grown from seeds collected from wild plants. Seeds can be broadcast directly onsite or in a nursery to produce seedlings for transplanting. February and March were the preferred months for sowing. Other species that showed promise for transplanting were grey dogwood (*Cornus racemosa*), silky dogwood (*C. amomum*), and black haw (*Viburnum prunifolium*).

Aspen can also be established in areas where it does not occur by planting seedlings obtained from a nursery (Gullion 1984). "Hybrid" poplars are available from nurseries but are not currently recommended (assuming benefits to grouse as well as woodcock are desired), because it is not known if their buds provide an acceptable food resource for grouse. Gullion recommended planting quaking aspen (*Populus tremuloides*) in more northern parts of the range and at higher elevations, and bigtooth aspen (*P. grandidentata*) in more southerly and lower areas. He suggested planting rates of 3,000/ha (1,200/acre) spaced about 2 m (6.5 ft) apart. This density is insufficient for providing adequate cover, so the stand should be cut at 10 years of age to encourage sprouting.

Harvest

A major factor affecting the overall woodcock population is the magnitude of the harvest. Annual production of woodcock is dictated by the quantity and quality of habitat (modified by weather), but since the majority of habitat is in private ownership, management on a large scale is impractical. Consequently, regulation of the harvest is the principal means of population management.

Because the woodcock is a migratory species, seasons and bag limits are established by the USFWS. Historically, the goal of woodcock population management has been to provide recreational opportunity (mainly hunting) without

jeopardizing the capability of the populations to maintain themselves (US Fish and Wildlife Service 1985). States are allowed to impose more restrictive but not more liberal regulations.

From 1967 until 1986, the states in both management regions were given a 65-day framework between the dates of October 1 and February 28 and a daily bag limit of 5 woodcock. Prior to 1967, the seasons had been more restrictive, with season lengths ranging from 15 days (1940-47) to 50 days (1963-66). Prior to 1964 the daily bag limit had been 4. Due to the steady decline in the Eastern population, the daily bag limit in that region was reduced at the beginning of the 1985-86 season to 3 birds per day, and the season length was reduced to 45 days between the dates of October 1 and January 31. Pennsylvania, Massachusetts, and Rhode Island had voluntarily reduced their bag limits in 1984, prior to the action taken by the USFWS. The goal of the USFWS is to manage the harvest so that the Singing Ground Index for the Eastern Region is 2.25 males per survey route (US Fish and Wildlife Service 1985).

Based on the Singing Ground Survey, the Central population has shown a slight upward trend (Bortner 1988); therefore, harvest restrictions have not been implemented. As of 1988, the Central Region maintains the 65-day season and a 5-bird daily bag limit.

POPULATION SURVEYS

Determining woodcock abundance is difficult because the birds are secretive and difficult to census by conventional means. In addition, woodcock habitat often consists of disjunct "pockets" of cover, so calculating a density estimate over a large area as is done with many species of birds is not appropriate. As a result, the population is monitored through the use of breeding indices and harvest data. Two main surveys provide the information needed to manage woodcock populations: (a) the Singing Ground Survey conducted in early spring and (b) the Wing Collection Survey conducted in the fall and winter. Neither survey can be used to estimate densities, but both provide a means of making relative comparisons and assessing population trends. Most of the information below is summarized from Tautin (1982), Tautin et al. (1983), and Bortner (1988).

Singing Ground Survey

The Singing Ground Survey is the main source of information used to estimate the abundance of the spring breeding population. The survey is coordinated by the USFWS in cooperation with the Canadian Wildlife Service and is run in 24 States and Provinces. It is based on a count of male woodcock heard calling along randomly selected 5.8-km (3.6-mile) routes. If possible, routes are located on lightly traveled secondary roads. In 1988, there were approximately 1,600 routes. Until the mid-1960's, the routes were run mainly through areas that were known to contain woodcock habitat. From 1967-70, these nonrandom routes were replaced with random routes through all habitat types because it was thought that the new procedures would more accurately reflect the status of the population. See Figure 3 for survey coverage.

The survey is conducted during the months of April and May, which is the primary breeding period in the northern portion of the range. Each route is begun at 22 min after official sundown (15 min earlier if the sky is more than 3/4 overcast). Conditions must be favorable for detecting calling birds, so routes are not run during hard rains or if there are strong winds. Cold temperatures result in the curtailment of courtship activity; thus, surveys are not conducted if temperatures are below 4.4° C (40° F). The observer makes 10 evenly spaced stops along the route, listens for 2 min at each stop, and records the number of "peenting" woodcock heard (flight songs are not counted). Appendix A shows the form used by cooperators running the Singing Ground Surveys.

Indexes are derived for both the Eastern and Central Regions by calculating the average number of males per route in each state or province and incorporating a weighting factor based on the size of the area. Population indexes are normally adjusted to a base year for comparison with previous surveys (Fig. 9).

Wing Collection Survey

Wings submitted by woodcock hunters provide a means of evaluating the success of the previous breeding season. The wings are used to determine sex and age characteristics of the harvest and to calculate a ratio of the number of immatures per adult female. A high ratio would indicate that the year was a favorable one for nesting and brood rearing.

Along with the wings from harvested birds, each cooperator is asked to provide additional information about the hunt. For example, how long (hours) was the hunt? How many woodcock were flushed? How many people were in the party? These statistics provide insight into the status of the fall population and a means of examining trends not only of hunter success, but of the interest in woodcock as a game species.

COMMENTS

The American woodcock is a very important game species throughout much of the northern portions of its range, with current trends suggesting that its popularity may increase significantly in the South during the next several decades. If this increase in popularity does occur, additional habitat management (and perhaps harvest regulation) will be needed to maintain the population at a level that can sustain the increase in pressure. Resource managers can do a great deal to improve conditions for woodcock through management practices they employ for other species such as ruffed grouse, white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), and bobwhite quail. Many of the management techniques discussed in this report are already routinely employed by resource managers, and it would often require only slight modification of existing strategies to provide considerable benefit for woodcock. Given the restrictive budgets that face most resource managers and the ever-increasing demands on all our wildlife resources, multispecies management will certainly pay large dividends in the long term.

Besides the attributes that make it an excellent game species, the woodcock can be a resource with a great appeal to the nonhunter. The male's spectacular courtship performance is enjoyed each year by the handful of biologists and dedicated bird-watchers who are aware of the unique ritual that takes place twice daily each spring. The resource manager who takes the initiative to locate a singing ground and inform the public of the location can provide the casual nature-observer with the opportunity to observe this normally secretive species.

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APPENDIX A

SINGING GROUND SURVEY FORM

NORTH AMERICAN WOODCOCK SINGING GROUND SURVEY

U.S. FISH AND WILDLIFE SERVICE,
OFFICE OF MIGRATORY BIRD MANAGEMENT, LAUREL, MARYLAND USA 20708-9619

CANADIAN WILDLIFE SERVICE, DEPARTMENT OF THE ENVIRONMENT
OTTAWA, ONTARIO, CANADA K1A 0H3

SURVEY YEAR

STATE OR PROVINCE

COUNTY

ROUTE NUMBER

DATE OF SURVEY

YEAR ____ MONTH ____ DAY ____

OBSERVER'S NAME (PRINT)

AGENCY 1 ☐ STATE 3 ☐ PROV. 5 ☐ FED.. 7 ☐ OTHER

WAS THIS ROUTE RUN BY YOU LAST YEAR? 1 ☐ YES 3 ☐ NO

MAILING ADDRESS STREET ____ CITY ____ STATE/PROVINCE ____ ZIP CODE ____

OFFICIAL SUNSET : PM

ROUTE NAME

SKY CONDITION (ADD 22 MIN. TO SUNSET FOR STARTING TIME)
0 ☐ CLEAR
1 ☐ 1/4 OVERCAST
3 ☐ 1/2 OVERCAST
5 ☐ 3/4 OVERCAST
7 ☐ >3/4 OVERCAST - ADD 15 MIN

TEMPERATURE
°F		°C
35-39	☐ 31	2-4
40-49	☐ 41	5-9
50-59	☐ 51	10-15
60+	☐ 60	16+

WIND
1 ☐ CALM
2 ☐ GENTLE (1-3 mph)
3 ☐ LIGHT (4-7 mph)
4 ☐ MODERATE (8-12 mph)
5 ☐ STRONG (>12 mph)

PRECIPITATION
0 ☐ NONE
1 ☐ MIST
3 ☐ SNOW, HEAVY RAIN
5 ☐ FOG
7 ☐ LIGHT RAIN

	STOP NUMBER	ODOMETER READING 1 ☐ MILES OR 3 ☐ KM	TIME	NUMBER HEARD PEENTING	DISTURBANCE (SEE BACK) NO[0]	LOW[1]	MOD[3]	HI[5]	REMARKS
	1		:						
	2		:						
	3		:						
	4		:						
	5		:						
	6		:						
	7		:						
	8		:						
	9		:						
	10		:						
	TOTAL WOODCOCK HEARD PEENTING								

DO NOT WRITE IN THIS LINE

TOTAL STOPS	ACCEPTABLE STOPS	TOTAL WOODCOCK ON ACC. STOPS	ROUTE STATUS	

SUNSET TIMES FOR THIS ROUTE:

DATE

DAYLIGHT SAVINGS TIME

STANDARD TIME

STATE/PROVINCIAL COORDINATOR:

PLEASE READ INSTRUCTIONS ON REVERSE SIDE CAREFULLY AND COMPLETELY.

Main Points to consider are listed below.

(1) Conduct survey within dates shown on map (see reverse).
(2) Make sure to conduct survey at proper time for sky condition.
(3) Stops should be at 0.4 mi (0.6 km) intervals, listen for exactly 2 minutes at each stop.
(4) Do not conduct survey if temperature is below 40°F (5°C), in strong wind, or in heavy precipitation.
(5) Contact your state coordinator promptly if unable to run your route within the designated dates.
(6) Fill out all sections of this form and immediately mail form.

FORM 2-180 (REV. AUG. 1987)

OMB NO. 1018-0019 APPROVAL EXP. AUG 1989

SURVEY BACKGROUND AND INSTRUCTIONS

The singing-ground survey provides an index to the relative size of the woodcock breeding population in North America. It is the most important source of data used to guide federal, state and provincial woodcock programs. As part of their courtship behavior, male woodcock exhibit aerial and vocal displays each evening. They begin by giving calls described as "peents" shortly after sunset. From openings called singing-grounds birds alternately "peent" and make flight songs. New survey participants should become thoroughly familiar with these woodcock sounds before running routes.

Originally, survey routes were run in areas of prime habitat where woodcock were known to be present, but subsequent studies showed that these counts did not accurately reflect overall woodcock densities. Consequently, new routes were selected randomly so that all habitat types would be surveyed and results would better reflect the status of the overall woodcock population. A normal characteristic of such random surveys is that some routes will fall in unfavorable habitat, so do not become disheartened if you do not hear birds on your route. Your results are still valuable.

Please follow the below instructions closely so that data from your route will be of maximum value. The quality of the survey depends on you.

OBSERVER — It is preferable that the same observer run the same route each year. When this is not possible, it is desirable for both observers (old and new) to run the survey together once so that there is a smooth transition with the new observer becoming thoroughly familiar with survey procedures and local route conditions. Both observers should record their results independently.

SEASONAL AND DAILY TIMING — Timing is very important. See the survey map for survey dates in your area. When spring is early or late, routes conducted up to 5 days outside the survey period will be accepted. Plan to arrive at the start of your route at or shortly after local sunset. If a time card accompanys this form use it to determine sunset. Otherwise, consult local news media. If the sky is clear or up to and including 3/4 overcast, add 22 minutes to the sunset time to determine the starting time. Add 15 minutes if the sky is more than 3/4 overcast. If your judgment dictates variation from this timing, as in the case of deep valleys, state the facts under "Remarks." Timing is very important! Do not use military time.

PROCEDURE — At stop no. 1 shut off your vehicle's engine, step several feet away and record the time you begin listening. Listen for 2 minutes and record the number of different woodcock heard "peenting." Then proceed rapidly 0.4 mi (0.6 km) to the next stop and repeat the procedure. Continue to do so until all 10 stops have been covered. If a bad traffic hazard prevents stopping within 100 ft. of the 0.4 mi. mark, proceed to the next stop and note "no stop-hazardous" in the space for the stop omitted. Be sure to check the survey form's box that indicates if your odometer readings are in mi. or km.

RECORDING COUNTS — Record the number of different "peenting" woodcock. Do not record birds you hear performing only the flight song, and do not record the number of "peents" heard. When no birds are peenting, record "0" in the appropriate column. When disturbances at a particular stop make a count absolutely impossible, note the type of disturbance and proceed to the next stop. Upon completion of the route, record the total number of birds heard.

DISTURBANCE

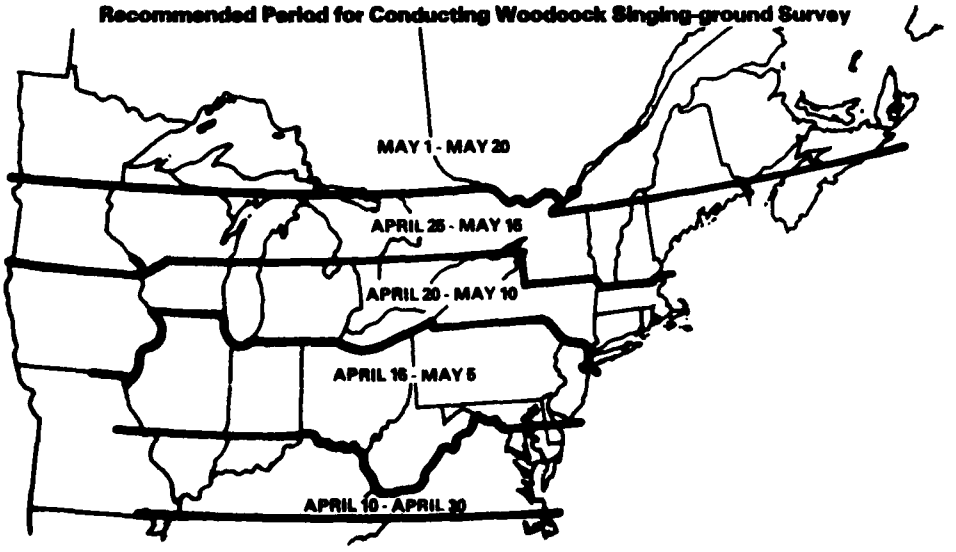
Disturbance	Description	Example
NO	No appreciable effect on count.	Occasional crow calling.
LO	Slightly affecting count.	Distant tractor noise.
MOD	Moderately affecting count.	Intermittent traffic.
HI	Seriously affecting count.	Heavy-continuous traffic.

THINGS TO AVOID — Do not run routes when the temperature is below 40°F, in heavy precipitation or strong wind.

NUMBER OF TIMES TO COUNT — Normally, conduct a route only once during the specified period. However, if weather or other factors cause invalid counts at five or more stops the route should be rerun another evening.

REPORTING — Immediately after running your route, mail an original copy of the form to: Woodcock Surveys, U.S. Fish and Wildlife Service, Laurel, Maryland 20708-4019, and mail 2 copies to your coordinator.

Your cooperation in this important survey is appreciated greatly. As soon as it is available, we will send you a report on the results of this year's singing-ground survey.



NOTICE

In accordance with the Privacy Act of 1974 (PL 93-579), please be advised that:

1. The gathering of information on migratory birds and their uses is authorized by the Migratory Bird Treaty Act (16 U.S.C. 703-711) and the Fish and Wildlife Act of 1956 (16 U.S.C. 742d).
2. Information from this survey will be used to further the understanding, management, and utilization of the North American migratory bird resource by Federal, State, and private conservation organizations, and the Canadian Wildlife Service.
3. Your participation in this survey is voluntary.